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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
**Bulletin 71**

# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN

## PART I. ASTRORHIZIDÆ AND LITUOLIDÆ

BY

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## ADVERTISEMENT.

The scientific publications of the United States National Museum consist of two series—the *Proceedings* and the *Bulletins*.

The *Proceedings*, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original, and usually brief, papers based on the collections of the National Museum, presenting newly acquired facts in zoology, geology, and anthropology, including descriptions of new forms of animals, and revisions of limited groups. One or two volumes are issued annually and distributed to libraries and scientific organizations. A limited number of copies of each paper, in pamphlet form, is distributed to specialists and others interested in the different subjects, as soon as printed. The date of publication is printed on each paper, and these dates are also recorded in the tables of contents of the volumes.

The *Bulletins*, the first of which was issued in 1875, consist of a series of separate publications comprising chiefly monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, and catalogues of type-specimens, special collections, etc. The majority of the volumes are octavos, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable.

Since 1902 a series of octavo volumes containing papers relating to the botanical collections of the Museum, and known as the *Contributions from the National Herbarium*, has been published as bulletins.

The present work forms No. 71 of the *Bulletin* series.

RICHARD RATHBUN,
*Assistant Secretary, Smithsonian Institution,*
*In charge of the United States National Museum.*

WASHINGTON, D. C., *June 18, 1910.*

# INTRODUCTION.

This paper is the first part of a work the intent of which is to describe and illustrate the Foraminifera of the North Pacific Ocean. This part includes the families Astrorhizidæ and Lituolidæ, together often known as the Arenaceous Foraminifera. These are usually considered the more primitive group and are therefore treated first.

The collection of recent Foraminifera in the United States National Museum has been carefully studied in so far as it represents the area in question. From the work of the various vessels of the Navy Department, the Coast and Geodetic Survey, and the Bureau of Fisheries a mass of material has accumulated which has been of great value in this work. A more detailed account of these collections will be given later.

There have been few works dealing with the Foraminifera of this area, and such records as exist have been included here. Except where acknowledgment is given, the figures have been drawn by the writer from material in the collection of the U. S. National Museum or have been reproduced from photographs taken at the National Museum of specimens in the same collection. Where recorded species are not well represented in the collection, figures from other works have been used and due acknowledgment given.

A considerable number of changes in the nomenclature and systematic arrangement have been made in an attempt to separate more clearly species and groups which, after a study of this material, seem to be distinctive.

I wish to express my great appreciation of the kindness with which the U. S. National Museum and its staff have so freely met my various needs in the preparation of this work.

Joseph Augustine Cushman.

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# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN.

## ASTRORHIZIDÆ AND LITUOLIDÆ.

By Joseph Augustine Cushman,
*Of the Boston Society of Natural History.*

### GENERAL ACCOUNT.

The Foraminifera are for the most part minute animals varying in size from a fraction of a millimeter to several millimeters in length, but may develop a test several inches across; these, however, are rare exceptions. A few species live in fresh or brackish water, but the great majority live in the ocean. They occur at all depths, but are most frequent at moderate depths in the ocean basins, where they form characteristic deposits—the so-called "globigerina ooze." In the vicinity of tropical coral islands many species occur in great abundance.

The animal itself is a single-celled form with one or many nuclei, as will be later explained. The test, in many cases at least, is really an internal structure, as the thin film of protoplasm which covers it in the perforate forms, and probably in others, is capable of secreting the material of the test, to repair breaks, etc.

Comparatively little is known concerning the animal of the Foraminifera except in certain littoral species. The great mass of the work on the group has been confined to a study of the empty tests. In the present work the material has been dried in almost all cases. As a result little has been noted in regard to the animal itself.

As single-celled animals the Foraminifera are especially interesting, and their structures do not need explanation on the basis of organs or tissues. There is much beauty in the curves of the test and in its ornamentation, the patterns of the latter often being very intricate.

For some time after their discovery the Foraminifera were thought to be a group of the cephalopods, and many of the coiled species have the appearance of minute nautiloid cephalopods. Many of the generic names were applied before the true relationships were known.

Many of the coiled forms were early described as species of *Nautilus*, and it was not until 1835 when Dujardin recognized the relationship of the group to the rhizopods that their systematic position was finally settled.

The classification of the group has been very differently treated by later writers. Led by W. B. Carpenter, there grew up what may be termed the English school of workers on this group. Four names stand out prominently, those of W. B. Carpenter, W. K. Parker, T. Rupert Jones, and H. B. Brady. The first three especially worked on the basis of no sharp lines of demarcation between species or genera or even between larger groups. The group was supposed to be very variable, in fact so much so that genera were recognized as tentative only and not really distinct. Brady, while holding many of the same views, nevertheless described many new genera and species, drew the lines more closely for the genera, and worked out a fairly good classification of the whole group. He was, however, led by the same plea of variation to unite recent forms with often dissimilar fossil species, on the basis of similar characters in one part or another, even while the whole test was often very different. With the large series obtained in the present work it is possible to show, not only that variation is not so great as was thought by the English school, but what was by them called variation is not variation at all but definite stages in the development of the test, which often at different stages has very different characters. In the light of the present knowledge of the life history and the microspheric and megalospheric forms these supposed variations take on a decidedly seemed to prove the contrary in regard to many species. With the lines of demarcation of species more closely drawn, it will be apparent that certain of them have well-defined areas of distribution and are found only between certain bathymetric altitudes. Not only is this true in regard to species, but various species form definite faunas, as will be later discussed. With plenty of specimens for comparison from different areas it is fairly easy to show the specific differences and the actual amount of the variation.

Throughout the group of the Foraminifera there is a nearly complete series, from a simple gelatinous covering of the cell in some of the fresh-water forms to the complex calcareous test of the higher groups. The fresh-water forms, while not considered in the systematic part of the present work, are nevertheless of especial interest on account of their primitive characters. In *Myxotheca* the simplest sort of covering is found, a gelatinous test which is flexible, so that it takes the shape of the changing form of the cell. There is here also no definite aperture, the pseudopodia being pushed through at any point. In others of the fresh-water forms the test may be of flexible chitinous material, but has a definite shape when the animal is at rest and usually one or more definite and permanent orifices.

In the marine species, which form the basis of the present work, there is usually a definite, specific form to the test and the aperture is permanent. The materials used in making the test may be grouped in two classes, (1) those derived from foreign sources, and (2) those secreted by the animal itself. The foreign materials are derived from the bottom on which the animal lives, and therefore even in the same species found under different conditions there is some variation in the character of the materials used. In general, however, there seems to be a certain amount of selective power on the part of certain forms, and such characters have been used as of generic rank in systematic work. The foreign material most frequently used is the mud or sand of the ocean bottom, but certain forms use sponge spicules, either making them into a soft felted mass (*Pilulina*) or arranging them in a definite manner and firmly cemented (*Technitella*). Other foraminiferal tests may be used, as may various small bodies which come within the range of the animals. The cement in the agglutinated tests may be chitinous, of iron oxide, or calcareous.

Of these calcareous tests two sorts have been recognized, one with a definite aperture or series of apertures and with minute pores (the perforate group), the other with a definite aperture or series of apertures but without minute pores (the porcellanous group). By many writers the latter group, represented by the Miliolidæ, has been held to be primitive and a group which had not developed perforations. On the other hand, certain evidence, such as the perforate condition of the early chamber of *Peneroplis* and other genera, would indicate that they are derived from the perforate group and that the lack of pores instead of being a primitive condition may in reality be a specialized one derived from a condition in which pores were developed throughout the life of the individual.

In general the test of the Foraminifera may be single chambered or many chambered. Contrary to the impression given by certain works on the group, the process of adding chambers in the Foraminifera, while superficially like budding or gemmation, is not necessarily or usually accompanied by nuclear divisions. That is, instead of the new chambers being potential individuals they are simply integral parts of one cell, and in the uninucleate form the single nucleus is found in about numerically the middle chamber. In the process of adding a new chamber a portion of the protoplasm is protruded from the aperture and a new chamber wall then formed about it. In some cases a complete wall is formed with each newly added chamber, but in others the adjacent parts of previous chambers form the inner walls of the new chamber and new walls are formed only on the free parts of the protoplasmic mass. In the open tubular test, such as *Astrorhiza* or *Hyperammina*, increase in the protoplasmic body is accompanied by addition of material at the open end of the tube and an increase in size results. In single-chambered types, such as *Lagena*, the manner of increase in size is problematical, if there be any at all. In such forms the entire test may be made in its completed form at once after division, as is the case with certain of the fresh-water Rhizopods.

## STRUCTURE.

group, as will be shown in certain of the families to be taken up later, when the details will be discussed at length. The term "dimorphism" would hardly cover the case in some genera, where eight or more distinct stages may be made out, each with its characteristic form of chamber, yet all appearing successively in a single test.

The number of chambers in the complex tests varies from a few to a great many. Where the size of the test becomes considerable and the chambers correspondingly large, the chamber is often divided up in various ways into chamberlets, as in *Orbitolites*. In such cases the adjacent chamberlets are usually in free communication with one another. The walls of the chamberlets give additional strength in many forms in which they are developed. Another characteristic modification in some genera is the development of labyrinthic structures in the interior of the chambers. Such structures are seen in *Cyclammina*, *Haplostiche*, *Fabularia*, etc. In general, it seems to be a mark of the culmination of certain lines in development, and many of the genera which developed such labyrinthic structures are now extinct. From the appearance of a series of such tests of one species at different stages in development, it would seem as though this labyrinthic condition was developed as a secondary growth in the chamber. One of its uses may be to give added strength to the test, but this does not always seem to be the case, for it may occur in tests which are characterized by thick walls.

### APERTURES.

The aperture in a given species seems to be rather constant when the development is understood. Much has been written upon this subject; apertural characters have been used by some authors as a basis for systematic work and discarded by others as very variable. In a few specimens it may seem at first sight as though the apertural characters were very variable, but with a large series showing different stages in development another phase of the matter is presented. In certain cases there is a very decided change in the condition of the aperture, but these changes appear at definite stages in the life history, and all may be seen by cutting back a single full-grown individual. In general, it has seemed from the present study that apertural characters, when studied in large series, are a rather dependable set for systematic work, and this will be shown to be true in the Miliolidæ and Lagenidæ especially.

In many species teeth of various sorts are developed in the aperture, and these teeth are subject to various modifications. It can be demonstrated that these modifications occur in a definite sequence, and that this sequence is important from a phylogenetic point of view.

In a considerable number of genera a definite tubular neck is developed, with the aperture at its end. This neck is seen in many genera in a great many modifications, and in *Lagena* the tube may be inverted and be directed into the chamber of the test.

It is obvious that a very long slit-like aperture may be a source of weakness to the test, especially when it is at the edge of a thin chamber. Usually in such cases, as in *Orbitolites*, the animal changes its aperture from a single one in each chamber to a considerable number. This is often coincident with the development of chamberlets, but not invariably so, for multiple apertures occur in *Peneroplis* where there are no chamberlets.

## ORNAMENTATION.

Many of the tests of the Foraminifera are beautifully ornamented. Raised costæ, striations, knobs, spines, and punctate areas form the main types of ornamentation. Several of these or combinations of them may occur in a single species, the form of the ornamentation often changing as the chambers of the test are developed. Certain of the simpler forms of ornamentation may occur as parallelisms in widely separated groups. As a rule, the proloculum and early chambers are smooth and unornamented, but there are certain exceptions, as in *Nodosaria*, for example, where in some species ornamentation may occur on the first chamber. In specialized genera it is not uncommon to find certain of the species with the early portion of the test ornamented, but the last-formed chambers with a loss of ornamentation and a consequent development of smooth chambers. On the other hand, there may be a thickening of the test from without and the covering of the chambers already formed with a secondary growth, often spinose. Such a condition is seen in some species of *Bulimina*.

often of a much lighter color than the rest of the test; on the other hand, in other forms, as in *Hormosina ovicula*, the tips of the chambers are often much darker than the rest. In the chitinous tests the usual yellowish-brown color of chitinous structures is present, and is somewhat variable in its tone.

In the secreted calcareous tests the usual color is white when empty. There are various exceptions, a reddish or pinkish color being most common, such as appears in *Globigerina rubra* and *Truncatulina rosea*, or perhaps more pronounced in *Polytrema minaceum*. In other calcareous species, as in various species of *Discorbina*, there is a brown color rather prominently developed. This is often confined to the earliest chambers, and the later ones may be white. In many species when alive there is probably more or less color which disappears when the test is empty.

## LIFE HISTORY.

For many of the Foraminifera two distinct phases have been discovered. One of these—the microspheric form—has a proloculum or first chamber of much smaller size than the other—the megalospheric form. These two forms are to be looked for in all species.

The microspheric form has a number of nuclei, often a larger number than there are chambers, scattered irregularly through the protoplasm of the body. There seems to be a rather definite relation between the size of the nuclei and the size of the chamber in which they occur, the larger nuclei being in the larger chambers and the reverse. Apparently these nuclei simply divide in their reproduction during the growth of the test.

When the animal attains its adult stage there is a great increase in the number of pseudopodia, and the entire protoplasm either leaves the test and accumulates about the exterior or is drawn into the outer chambers. Finally, each nucleus gathers a mass of protoplasm about itself and secretes the proloculum of a new test. This newly formed proloculum is of the larger type and is the first chamber of the megalospheric form, instead of being of the same size as that of the microspheric parent from which it was derived. The megalospheric form differs from the microspheric form in having a single nucleus. This does not divide, but moves along as new chambers are added, keeping in about the middle chamber numerically. Nucleoli appear in increasing numbers as the growth continues, and finally the whole nucleus breaks down and a great number of minute nuclei appear. These draw about themselves portions of the protoplasmic mass and then divide by mitotic division. Finally, the mass leaves the test in the form of zoospores. These are then supposed to conjugate and to give rise to the small proloculum of the microspheric form, thus completing the life cycle, although the actual process of conjugation has not definitely been observed in this group. The empty tests left behind must form a large proportion of the dredged Foraminifera. The two forms may be distinguished by the size of the proloculum and, when sufficiently known, by other characters as well.

The microspheric form is thus the result of a conjugation or a sexual process, while the megalospheric form is the result of simple division or an asexual process. As a rule the megalospheric form is by far the more common, and in many species the microspheric form is very rare, or even as yet unknown. The microspheric form, while it starts as a smaller individual, in most cases attains a much larger size than the megalospheric, as might be suspected from the nature of the reproductive processes by which it is formed. In species where there are definite stages in development it is usually the microspheric form which repeats these most fully, these stages being reduced or entirely skipped in the megalospheric form of the species.

In some cases the megalospheric form may give rise to a group of megalospheric young instead of to zoospores. On the whole, the life cycle agrees well with the alternation of generations as seen in certain other groups of animals.

## PELAGIC FORAMINIFERA.

All of the Foraminifera may be divided into two classes, those which are known to live at the surface, relatively a small number, and those which have been found only on the bottom, which form the great majority.

The pelagic species number but little more than twenty, and of these few are really common at the surface. The two genera which the last-formed chamber of the adult. There is also a tendency for the last-formed chamber to surround the preceding, ones either entirely, as in *Orbulina*, or in part, as in some of the species of *Globigerina*. Some of the species develop very long spines on the surface of the test. Most of the species also develop a spherical or nearly spherical test which, as has been shown by Rhumbler, is the form which requires the least amount of secretion to cover the animal. In the matter of the size of the perforations also there is a difference, even in species of the same genus, between those living at the surface and those on the bottom, those of the surface forms being several times as large as those of the bottom ones. In general, while the various structures mentioned are also found in the bottom species to some extent, they are strikingly characteristic of the pelagic Foraminifera.

Evidently the pelagic character has been developed independently, as there are members of three or more families represented. The structures which they have developed in common, therefore, are to be regarded as parallelisms due to similar environmental conditions.

## FOOD.

In general, the food of the Foraminifera consists of vegetable matter, the diatoms and algæ of various sorts furnishing the greater part. In some of the pelagic forms, however, it has been observed that copepods are caught and eaten, and some other Protozoa are also caught.

## COLLECTION AND PRESERVATION.

For one living near the ocean it is very easy to obtain material for making a preliminary study of the Foraminifera. On stones, on the piles of wharves and bridges, in fact upon almost anything that is stationary for any length of time in the salt water, the Foraminifera will be found in greater or less quantity. In the sand of tide pools many species may be found, and in the sand dredged from a few fathoms there are sure to be some tests present. If locality is not important, and one merely wishes to become acquainted with the various forms, they may be found in the sand from sponges, from the "chain lockers" of ships, etc.

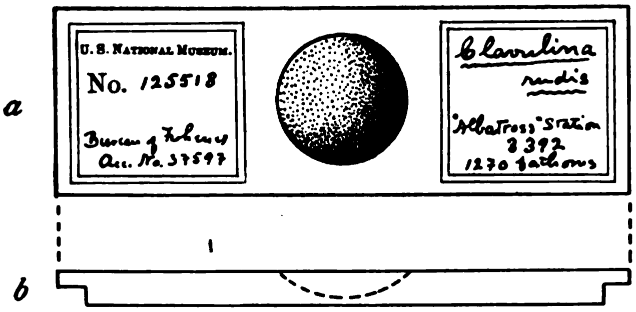
For the study of a definite region involving any considerable depth of water a special dredging apparatus must be used, together with the various appliances used in deep-sea work. As such methods are too elaborate for individual work as a rule, it must be left largely to government vessels and to especially equipped scientific expeditions. For getting together material for the study of a definite fauna, such as that of the North Pacific, it is necessary to depend almost wholly upon the work of such specially equipped vessels. The samples that are brought up from the ocean bottom must be washed in some way to separate the mud from the other material. One of the easiest and most expeditious ways is to shake the material in a cloth immersed in water. This quickly washes out the mud and leaves the Foraminifera with more or less sand, fine shells, and like objects. Such material when dried is easily examined, and the Foraminifera desired may be picked out with the tip of a needle moistened slightly or with a fine brush.

For the mounting of the Foraminifera for permanent preservation nothing better seems to be available than the wooden slides mentioned by Dr. James M. Flint. These are of wood with a concave boring in the middle of one side. The slides themselves are 3 inches long and one inch wide. Some of them as used in the present study have been made thin enough to fit into an ordinary slide box, and have a small concave portion, while another lot has been used nearly twice as thick, but cut at the ends so as to slide into the grooves of a slide box. These latter are drilled with a larger and deeper concavity and are used for the arenaceous and other large species. The bottom of the concavity is blackened with drop black, and the cover is made of a slip of mica held in place by a spring made of a thin strip of brass bent to conform to the two sides of the slide with enough spring in the strip to make it act as a clamp to hold the piece of mica securely. This clamp may be easily slipped off when the specimen is to be critically examined, or with a hand lens the specimen may be studied directly through the mica. The specimens are dropped into the cavity and not fastened in any way, and are therefore available at any time for h a little xylol and then the glue dissolved by water. By turning specimen over and repeating the process a thin section may be ained, which may then be mounted permanently. By this means arrangement of chambers in the interior of a test may be studied, n when they may be entirely hidden in an ordinary external view.

## HISTORICAL.

he North Pacific Ocean as a whole has received less attention, ept from the United States vessels, than any of the great ocean

*A*



*B*

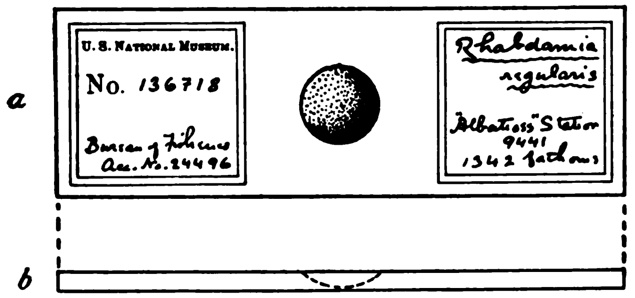


FIG. A.—THICK SLIDE. *a*, SURFACE VIEW; *b*, SIDE VIEW, SHOWING GROOVED END FOR FITTING INTO SLIDE BOX.

FIG. B.—THIN SLIDE. *a*, SURFACE VIEW; *b*, SIDE VIEW.

ins. The idea has been prevalent that it was largely a vast red-y area of great depth. This was mainly a result of the voyage of *Challenger*, which certainly did follow a course leading over such ortion of the bottom. On the whole, the generalization is true t the ocean bed of the North Pacific is a great red-clay area. In te of this fact, there are, as was shown by the work of the *Nero*, siderable areas of globigerina ooze containing abundant Forami-era. As the aim in the present work is to include all records for this region, a short review of the work done on the Foraminifera will not be out of place.

Ehrenberg had material from many parts of the world, and some of his samples included specimens from this area. Carpenter's work really gives an idea of certain of the Philippine forms. He mentions several species as occurring here, and notes that they vary more or less from what he terms the same species from the Mediterranean. Definite data are not given, and the few species noted as occurring in the region are not given further attention in this work, as they are for the most part the larger and more common shallow-water species of the tropical coral-reef fauna.

It is in Brady's Report on the *Challenger* Foraminifera that the first real sketch of the foraminiferal fauna of the North Pacific is given, especially that of the deeper portions of the adjacent seas. A considerable number of species and varieties are recorded from this area, but the great majority of these are from three regions, really from three stations. In point of view of richness, these are, first, the coral reefs of the Hawaiian Islands, at a depth of 40 fathoms; next a station off Japan on the *Hyalonema* ground, in 345 fathoms; the third station is just west of the Philippines, in 95 fathoms. These three stations together furnished a large part of the North Pacific records of the *Challenger* Report. Many of the other stations gave but a few species; some none at all. From these facts it might be imagined that the rich fauna of this area is in the shallow water, and this has proved to be the case. As a rule, the globigerina ooze away from the oceanic islands is uninteresting, consisting almost exclusively of the pelagic types of *Globigerina*, *Pulvinulina*, *Sphæ-*

both as to depth and bottom conditions. A considerable number of new species was discovered, and from the list of species given much can be made out as to the characters of the fauna. Goës returned to the National Museum a set of nearly all the species he recorded, and his selected material has been carefully studied in connection with the present work.

In 1899 Flint's report on the *Albatross* Foraminifera[a] added to the previous knowledge by records from scattered stations on the west coast of North America and a few species from the western Pacific. Most of the stations from which the material was taken for his report were in the North Atlantic. His report on the *Nero* material[b] added a few records to the previous ones, although in that report as a rule only the genera were mentioned, the work dealing with oceanography rather than determination of the species in the deposits. Something of the general character of the fauna of various areas may be ascertained from the genera mentioned.

In 1906 Rhumbler reported[c] upon material from Laysan and the Chatham Islands. The material came from shallow water. Of the species recorded a considerable number were described as new. These records are especially interesting as they represent the littoral fauna not previously recorded, except from the Hawaiian Islands in the *Challenger* Report. Rhumbler's records show the existence of a shallow-water fauna of tropical character about these islands, and the new species indicate the individuality of these more or less isolated areas.

In 1908 Bagg[d] recorded a considerable number of species from the immediate vicinity of the Hawaiian Islands. These records add considerably to the recorded fauna of the shallower water as given in the *Challenger* Report. In this *Albatross* material the stations reported upon were mainly in globigerina ooze and for the most part lack the shallower water species so common on the coral reefs of this region. The series selected by Doctor Bagg has been examined and the results of this examination appear as the species are discussed.

Altogether the eight titles mentioned have built up a rather numerous fauna for the North Pacific, but the material that was available for all of them was rather meager when compared with the material available for the present work. As a result, not only has a very large proportion of the previously recorded species been rediscovered, but a great many species have been added, some new, and some previously described from other areas. The large series of specimens has added greatly to the ranges of distribution for species which were formerly known only from isolated stations and has shown the incorrectness of the determination of many species of this region as identical with species characteristic of the fossil beds of Europe.

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[a] Rep. U. S. Nat. Mus., 1897, (1899) pp. 249–349.

[b] Bull. 55, U. S. Nat. Mus., 1905.

[c] Zool. Jahrb. Abt. Syst., vol. 24, pp. 21–80.

[d] Proc. U. S. Nat. Mus., vol. 34, pp. 113–172.

## SOURCES OF MATERIAL.

*U. S. Fisheries steamer Albatross.*—The greatest part of the work of making known the ocean bottom of the North Pacific has been done by the U. S. Bureau of Fisheries steamer *Albatross*. For the last twenty years the *Albatross* has been in the Pacific Ocean and has occupied several thousand dredging and hydrographic stations. In the present work these will be referred to in the usual manner, as "station D5056" or "H3228," etc. Of the *Albatross* material, that from a considerable number of stations was available from the work of the earlier years. These stations were chiefly along the Pacific coast of the United States, British Columbia, and Alaska. During the early part of 1891 dredging operations were carried on off the coast of California, Mexico, and Central America, and out to the Galapagos Islands. The material collected was worked up by Goës and is recorded in his paper already referred to. Later, in 1891 and continuing into 1892, the *Albatross* was engaged in a cable survey between California and the Hawaiian Islands. About 550 stations were occupied and a mass of material from a definite line across that part of the Pacific was gathered. As is the case in so many parts of this ocean basin, the depth for much of the distance surveyed was too great for the existence of many Foraminifera, the majority of the soundings consisting of typical red clay. In certain parts of the described by Brady in the *Challenger* Report as from this region only. The more extended work of the *Albatross* adds much to our knowledge of the real distribution of these species formerly known from only a single station.

*U. S. S. Nero.*—Next in importance to the work of the *Albatross* has been that of the U. S. S. *Nero*, which in 1899 and 1900 made a detailed cable survey across the North Pacific from the Hawaiian Islands to Midway Island, thence to Guam, to Luzon, to Guam, to Yokohama, to Guam, to Midway Island, and then back to the Hawaiian Islands. Thus a very complete line of soundings was made, giving, in connection with the 1891–92 survey from California made by the *Albatross*, a complete line of soundings and of bottom samples across the whole North Pacific. The work of the *Nero* by actual distance of the course of the survey gives on an average a record for every few miles of the distance. Such detailed work has not been available for any such distance before. Much of the work was in very deep water in red clay areas, and the results as to the Foraminifera practically *nil*, but many areas of shallower water were covered with typical globigerina ooze conditions. The areas about the various centers of work at Honolulu, Midway, Guam, etc., gave an excellent series of Foraminifera. About 750 bottom samples from work of the *Nero*, mostly from the shallower areas, were examined and much was thereby learned in regard to actual distribution of the various species, many of the results of decided importance in delimiting faunal areas for the North Pacific.

*U. S. S. Alert.*—A considerable number of bottom samples was available from the work of the U. S. S. *Alert* in the western Pacific. As a rule, these were in the vicinity of the Bonin Islands and near other volcanic islands, containing in general little of interest, yet certain of the samples had many interesting species and add stations which otherwise would not have been accessible.

*Miscellaneous.*—Scattered material from various sources has also been available, from the China Sea, Hongkong, and various shore stations in the Philippines. All have added interesting data, although the material from such sources was not usually rich in Foraminifera.

Strangely enough, the region from which the least material was available is that of the west coast of the United States. This is partly due to the fact that the *Albatross* when in these waters is often engaged in work other than that of dredging. Enough material is available, however, to show that the region is a peculiar one in many respects.

## DISTRIBUTION AND ITS FACTORS.

In relation to the Foraminifera there are three conditions which are of importance in addition to the character of the bottom—depth, temperature, and ocean currents.

In regard to the first of these conditions it may in general be said that there are almost no calcareous Foraminifera to be found in depths greater than 2,500 fathoms. There are certain exceptions to this, but the number of such exceptions is very small. In greater depths than this there are to be found certain species of the arenaceous Foraminifera, which have been found at the greatest depths that dredgings have been made. The reason for the practical disappearance of the calcareous forms below the 2,500-fathom line has not yet been definitely settled. It has been thought that the great pressure at that depth has made their dissolution much easier than at shallower depths, but this has not been conclusively demonstrated.

Besides the disappearance of certain groups of forms through dissolution, there are found to be rather definite limits to the range in depth of any particular species when a considerable series may be had for study. Many species are found only in very shallow water, such as *Alveolina, Amphistegina,* etc. They may be found occasionally at considerable depths in the vicinity of oceanic islands, such as Guam, where the currents carry them into deeper water, but even in such cases the tests show the effects of wave action and are as a rule tests which were apparently empty before they were carried out to this depth. In the neighborhood of such islands very strange mixtures of deep-water with shallow-water species may be found, and mingled with the other two are often many of the typical species of the globigerina ooze.

Bottom temperature has in some cases an apparent influence upon the distribution of certain species. For example, certain species of great ocean depths are very uniform, and it is in this portion of the ocean basins that universal distribution is to be looked for. Many species found at depths of 1,000 fathoms, for example, are probably to be found in similar depths in any of the great ocean basins. This is even more true of those species which are encountered at the 2,000-fathom line. At depths of less than 500 fathoms species occur which in many cases seem to have a rather limited range. Many such species have been found—species, for example, which were recorded by Brady from material from a single *Challenger* station, and have been found again in the present study on the *Albatross* material from exactly the same regions and at approximately the same depths. Such species may be considered as marking definite faunal limits where enough such species occur in any one region. On this basis the North Pacific Ocean may be divided up into several faunal regions, which, while they may have a considerable number of species in common, nevertheless have a distinctive character as a whole.

Among the most characteristic of these faunas may be mentioned the coral-reef fauna, as it may be conveniently called. This fauna, characterized by such genera as *Orbitolites*, *Alveolina*, *Peneroplis*, *Amphistegina*, *Polytrema*, etc., is found about the coral reefs of the Philippines, the Hawaiian Islands, Guam, and other of the tropical oceanic islands of this area. It is best developed about the first two groups of islands at comparatively shallow depths. In the north this fauna extends, with certain modifications, up to the southern portion of Japan, but so far as made out it is not developed at all on the eastern coast of the North Pacific. The same fauna is found in the Malay Archipelago, in various parts of the East Indies, off the northern coast of Australia, to some extent in various parts of the Mediterranean, and also a modification of it in the West Indies.

Off the coast of Central America and Mexico there is developed a peculiar fauna which is seen in a modified form in the deeper waters off the eastern coast of the Philippines. Certain of the species, or at least the genera, are also characteristic of certain parts of the extreme North Atlantic, where they have been described by Brady from the *Porcupine* and other dredgings. Some of the genera which are characteristic of this region are *Crithionina*, *Bathysiphon*, large species of *Reophax*, *Verrucina*, etc.

Off the coasts of Japan and of the Philippine Islands in green mud at depths of a few hundred fathoms there is another rather definite fauna, which is mainly characterized by many species of the Lagenidæ, such as *Sagrina bifrons* H. B. Brady, and many of the species recorded by Brady from the *Hyalonema* ground south of Japan in about 300 fathoms. This fauna appears to run northward a considerable distance along or off the Japanese coast and to extend eastward to the

Ladrone Islands and southward through the Philippines to the region north of Australia.

Besides these three, which are rather definite in their limits, there are many more minor faunas which may be made out, but which are not of sufficient importance to be mentioned here. One example, for illustration, is the cold area extending around the northern portion of the North Pacific and Bering Sea. This is marked by such species as *Polystomella sibirica* Goës, etc.

On the whole, while the North Pacific is not as interesting perhaps as is the North Atlantic, there are portions of it which are very rich in species which are represented by an abundance of specimens.

The systematic portion of the work has been written on the basis of the distribution in the North Pacific entirely, and the stations are given with this in mind. Occasionally mention of other regions is made, but only when this has some special bearing on this region.

## SYSTEMATIC PART.

## Order FORAMINIFERA.

Pseudopodia of fine threads, freely anastomosing to form a network; test typically with many minute foramina, in one family with a single aperture; wall of the test composed of chitinous or calcareous material when secreted, or of agglutinated sand, sponge spicules, shells, etc., usually secreting either no silica or a very little under certain conditions.

### [Family 1. GROMIDÆ.

base to which the foreign material is attached. There seems to be a regular succession of forms from *Astrorhiza*, in which there is a central chamber with many irregular openings to the tubular form open at both ends and of indefinite length, thence to the chamber closed usually except at a single point as *Proteonina* or with several apertures as in *Thurammina*. This single-chambered form then leads to the forms with a globular proloculum and an elongated chamber, but undivided. Occasionally tests are found as in *Rhabdammina discreta*, where there are external constrictions, but without complete divisions within.

### Subfamily 1. ASTRORHIZINÆ.

Test consisting usually of a tube open at both ends or in some species of *Astrorhiza* with several tubes entering a central chamber; in some species with the tube branching (*Rhabdammina irregularis*, *Rhizammina algæformis*, etc.).

Included in this subfamily are five genera, *Astrorhiza*, *Rhabdammina*, *Marsipella*, *Bathysiphon*, and *Rhizammina*. With the exception of the first we know very little concerning the animal, excepting for the material of which the test is made; each consists of a simple or branching tube open at the ends, except in some species of *Astrorhiza*, where there are several tubes and a single central chamber. The growth seems to take place by the addition of material at the open ends of the tube, thus increasing the length.

### Genus ASTRORHIZA Sandahl, 1857.

*Astrorhiza* SANDAHL (type, *Astrorhiza limicola* SANDAHL), Öfv. Svensk. Vet. Akad. Förh., vol. 14, no. 7, 1857, p. 299.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 230.

*Astrorhiza*+*Rhabdammina* (part) EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 666.

*Ammodiscus* CARPENTER and JEFFREYS, Proc. Roy. Soc. London, 1870, p. 159 (not *Ammodiscus* REUSS, 1871).

*Arenistella* FISCHER and DEFOLIN, Les fonds de la mer, vol. 2, 1872, p. 26.

*Astrodiscus* F. E. SCHULZE, II Jahr. Comm. wiss. Unt. deutsch. Meer in Kiel, vol. 1, 1875, p. 113.

*Hæckelina* BESSELS, Jen. Zeitschr., vol. 9, 1875, p. 265.

*Description.*—Test free, flattened or tubular, composed of sand or mud loosely cemented; chamber within connecting with the exterior by the open ends of the tubes or by several definite apertures in the flattened forms.

Five species occur in the North Pacific, so far as is known. They are typically cold-water species here, as also in the North Atlantic. None of the species seem to be common so far as the material that has been examined shows.

### ASTRORHIZA ANGULOSA H. B. Brady.

*Astrorhiza angulosa* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 48; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 234, pl. 20, figs. 10–13.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 19.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 265, pl. 3, fig. 1.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 218, fig. 38 (in text).

*Description.*—Test depressed, subtriangular (rarely quadrangular), biconvex, rounded at the edges, interior consisting of a small central chamber from which tubes radiate, one to each angle of the test, their open ends serving as apertures; wall thickest about the central chamber, composed of fine sand, exterior of the test loose and granular, within, smoothly finished, wall about the apertures often tinged a reddish-brown.

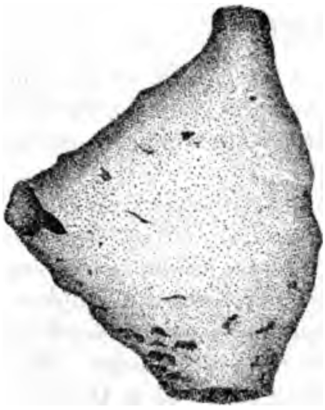


FIG. 1.—ASTRORHIZA ANGULOSA. × 15.

Diameter, 2–4 mm.

*Distribution.*—This species was obtained by the *Albatross* at a single station, D3407, off James Island, Galapagos, in 885 fathoms from globigerina ooze.

Of the four specimens from this station in Goës' material, two have the darker-colored neck as shown in Brady's figures (pl. 20, figs. 11, 12).

### ASTRORHIZA FURCATA Goës.

*Astrorhiza furcata* GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 19, pl. 1, figs. 4, 5.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 218, fig. 39 (in text).

*Description.*—Test flattened below, convex above, triangular, with three tapering arms, attenuated at their ends, which serve as apertures; angles between the arms unequal, the arm opposite the smallest angle usually longer than either of the other two; wall of medium thickness, composed of mud and fine sand with occasional larger fragments; texture of wall fairly firm, more so than in most of the other species of the genus, color dark gray or almost black.

Length about 5 mm.

*Distribution.*—Obtained by the *Albatross* at a single station, D3419 off Acapulco, on the west coast of Mexico, in 772 fathoms in green mud. This is the type station.

The three specimens selected by Goës from the original station are figured here. They show the variation in form as well as other slight differences. One or two other specimens were also found in looking through the material from this station. The species is different in various ways from typical *Astrorhiza* but may be left here until more

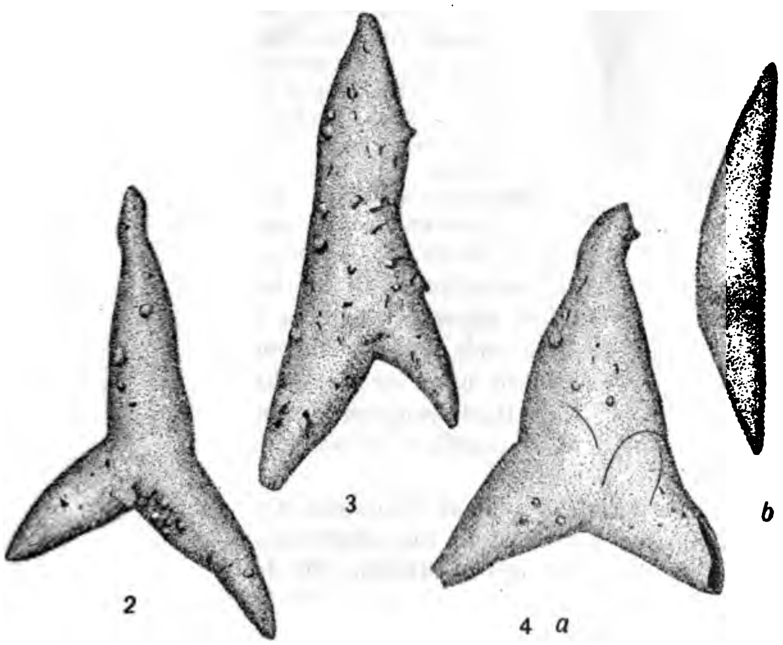
### ASTRORHIZA GRANULOSA (H. B. Brady).

*Marsipella granulosa* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 36, pl. 3, figs. 8, 9.—BÜTSCHLI, in Bronns, Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 194, pl. 5, fig. 9.

*Astrorhiza granulosa* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 48; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 234, pl. 20, figs. 14-23.—NEUMAYR, Stämme Thierreichs, vol. 1, 1889, p. 173, fig. 17*d*.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 19.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 265, pl. 1.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 219, fig. 41 (in text).

*Rhabdammina granulosa* EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 667.

*Description.*—Test fusiform, tapering toward the ends, internally with a long tubular chamber of nearly uniform diameter, open at both ends, the apertures sometimes more or less closed by particles of sand; wall composed of fine siliceous sand, loosely cemented externally, occasionally with tests of *Globigerina* or other foreign particles cemented into the test, ends often with a brownish tinge, the rest of the test grayish.



FIGS. 2-4.—ASTRORHIZA FURCATA. 2, 3, 4 *a*, FACE VIEW OF THREE SPECIMENS SELECTED BY GOËS FROM THE TYPE STATION; 4 *b*, SIDE VIEW. × 10.

Maximum length, 5-7 mm.

*Distribution.*—I have had material of this species from four stations in the North Pacific. Of these one is the station recorded by Goës, *Albatross* station, D3375, southwest of Panama in 1,201 fathoms from globigerina ooze. The other three stations are in the Northwest Pacific, dredged by the *Albatross* in the 1906 cruise, D4979, 943 fathoms, D5031, 86 fathoms, and D5095, 58 fathoms. The first of these stations is in the southern portion of the Japan Sea, the other two being in shallow water south of Honshu Island, Japan.

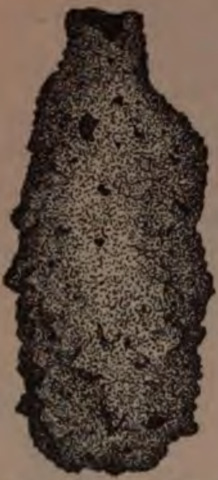


FIG. 5.—ASTRORHIZA GRANULOSA. × 10.

The two stations from shallow water are in the influence of cold currents and this may account for the finding of this species at depths so much shallower than the previous records.

### ASTRORHIZA CRASSATINA H. B. Brady.

*Astrorhiza crassatina* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 47; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 233, pl. 20, figs. 1-9.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 13, pl. 2, figs. 11-15; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 19.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 265, pl. 2.—KIÆR, Norske Nordhavs-Exp., no. 25, 1899, p. 4.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 220, fig. 42 (in text).

*Rhabdammina crassatina* EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 668.

*Description.*—Test subcylindrical or irregular, elongate, ends rounded, internally with a tubular chamber, open at both ends, but of uneven diameter, the apertures often more or less closed by particles of sand; walls thick, composed of fine sand, loosely cemented at the surface; occasionally with various foreign particles.

Maximum length of typical specimens, 8–10 mm.

*Distribution.*—Obtained by the *Albatross* at three stations in the 1906 cruise, D4946, 39 fathoms, D4949, 110 fathoms, and D4979, 943 fathoms. These three stations are near Japan—one south of Honshu Island, the other two southeast of Kiushu Island. All three of these are within the influence of the cold currents from the north. Goës records this species from *Albatross* station D3407, off James Island, Galapagos, in 885 fathoms from globigerina ooze.

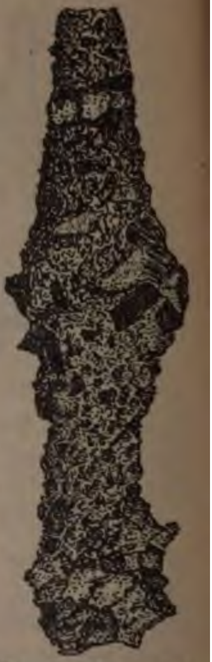


FIG. 6.—ASTRORHIZA CRASSATINA. × 10.

The specimens referred to this species by Goës are not typical. They are large, very rough, irregular tubes, with a very narrow and little dilated chamber, the longest specimen measuring nearly 25 mm. Just what these tubes are it is difficult to say, but their questionable position must simply be noted until living material can be studied.

### ASTRORHIZA TENUIS Goës.

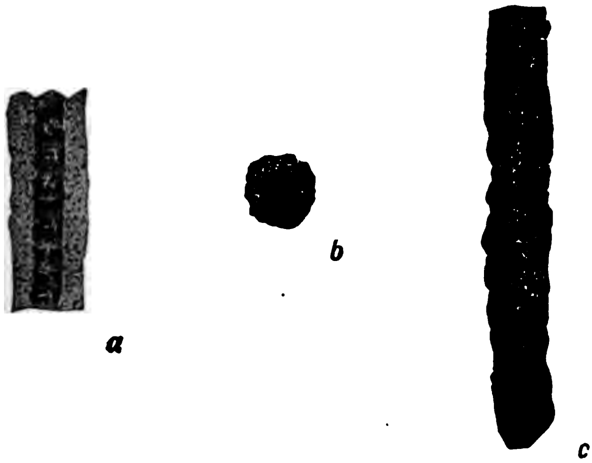
*Astrorhiza tenuis* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 20, pl. 1, figs. 6–8.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 220, fig. 43 (in text).

*Description.*—"More or less slender cylindrical or fusiformed tubes, usually tapering to the ends, with constricted apertures. Tube channel smooth, with faint traces of spurious septa. Wall loosely cemented of coarse sand, light grayish, comparatively thick."

"Length 5–10 mm.; diameter 1–1.5 mm."

*Distribution.*—Described by Goës from *Albatross* station D3431, 995 fathoms, at the entrance to the Gulf of California.

In the collection at Washington there are no specimens of this species in the material returned by Doctor Goës. No specimens which can be definitely assigned to this species were found in an examination of the unsorted material from this station. The description and figures are given from Goës's original paper. It seems to me questionable whether this is a true *Astrorhiza*, but without specimens it is difficult to decide.



Figs. 7.—Astrorhiza tenuis. *a*, longitudinal section; *b*, transverse section; *c*, side view of exterior. (After Goës.) × 6.

## Genus RHABDAMMINA Carpenter, 1869.

*Rhabdammina* M. Sars, Forh. Vid. Selsk. Christiania, 1868, p. 248 (*nomen nudum*).—W. B. Carpenter (type, *R. abyssorum* W. B. Carpenter), Ann. Mag. Nat. Hist., ser. 4, vol. 4, 1869, p. 288; Proc. Roy. Soc. London, vol. 18, 1869, p. 60.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 266.

*Astrorhiza* (part)+*Rhizammina* (part) Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 666.

*Description.*—Test free, tubular, either straight, radiating from a common center or branching, open ends of the tube serving as apertures; wall coarsely arenaceous, usually more or less rough, firmly cemented.

This genus includes five species, four of which are now known from the North Pacific. As they are, as a rule, deep-water species, little is known concerning the soft parts. It seems likely that there is a more definite beginning to such a test as that of *R. irregularis* than has been seen. All the specimens have the appearance of being broken at the lower end.

### RHABDAMMINA ABYSSORUM W. B. Carpenter.

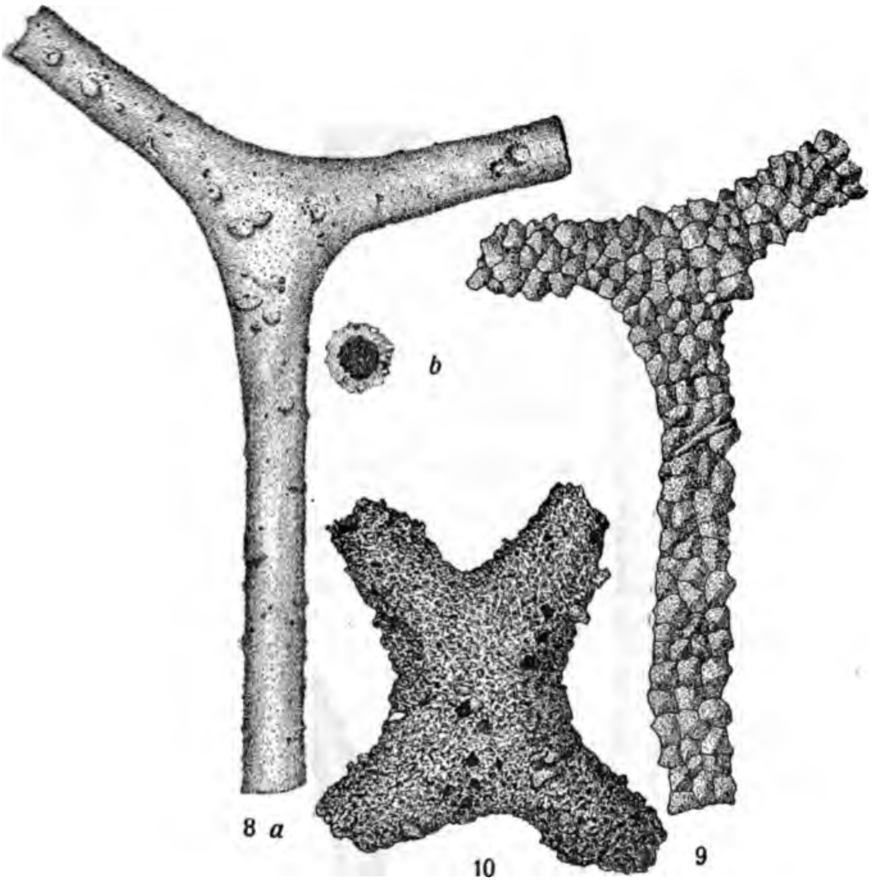
*Rhabdammina abyssorum* M. Sars, Forh. Vid. Selsk. Christiania, 1868, p. 248 (*nomen nudum*)—W. B. Carpenter, Ann. Mag. Nat. Hist., ser. 4, vol. 4, 1869, p. 288; Proc. Roy. Soc. London, vol. 18, 1869, p. 60.—G. O. Sars, Forh. Vid. Selsk. Christiania, 1871, pp. 250, 251.—Carpenter, The Microscope, 6th ed., 1881, pp. 562, 563, figs. 321 *c*, *d* (in text).—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 266, pl. 21, figs. 1-13.—De Folin, Le Naturaliste, vol. 9, 1887, p. 127, fig. 12*a*.—A. Agassiz, Bull. Mus. Comp. Zoöl., vol. 29, 1888, pp. 162, 163, figs. 492, 493 (in text).—Newmayr, Stämme Thierreichs, vol. 1, 1889, p. 173, fig. 17*a* (in text).—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 255, pl. 4, fig. 31.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 19, pl. 4, figs. 67, 68.—Schlumberger, Mém. Soc. Zool. France, vol. 7, 1894, p. 254.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 21.—Kiær, Norske Nordhavs-Exp., no. 25, 1899, p. 4.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 271, pl. 12, fig. 2.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 264, fig. 108 (in text).

*Rhabdammina abyssorum*, var. *robusta* Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 143, pl. 12, figs. 430, 431.

*Astrorhiza abyssorum* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 666.

*Description.*—Test free, consisting of a central chamber with three to five radiating arms, usually three, of nearly uniform diameter

There is a considerable variation in this species along certain lines. Typically there are three arms, but there are occasionally four or five, these specimens usually being rare. However, at station D4337, off San Diego, California, there was obtained a considerable series of specimens of this species and among these examples with four or even five arms were rather common. In the matter of texture of the wall there is also a considerable variation, partly due to bottom conditions it would appear from the material examined. The specimens from shallower water are more apt to be constructed of coarse sand grains, figure 9, while those from deep water where such materials are lacking are made of much finer grains with more or less mud and often contain *Globigerina* or other tests in the wall. This species has been usually found in deep water, all but four stations being in water more than 600 fathoms deep.

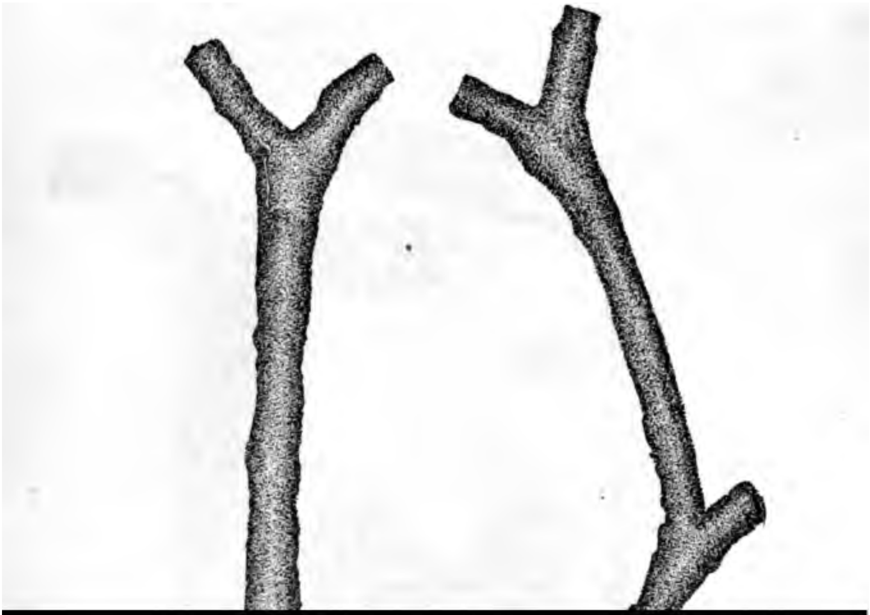


FIGS. 8–10.—RHABDAMMINA ABYSSORUM. 8*a*, FRONT VIEW; *b*, END VIEW OF ONE ARM OF THE SMOOTHER FORM FROM DEEP WATER, × 10; 9, FRONT VIEW OF A SHALLOW WATER SPECIMEN FROM THE COAST OF JAPAN, × 25; 10, CENTRAL PORTION OF A SPECIMEN WITH FOUR ARMS, × 15.

### RHABDAMMINA IRREGULARIS W. B. Carpenter.

*Rhabdammina irregularis* W. B. CARPENTER, Proc. Roy. Soc. London, vol. 1869, p. 60.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884 268, pl. 21, fig. 9.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 21 RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 263, fig. 106 (in text).

*Description.*—Test made up of a dichotomously branching tubul chamber, of nearly even diameter, wall of firmly cemented sa



Length, up to 37.5 mm.

*Distribution.*—In the *Albatross* material from the west coast of Mexico and Central America this species forms what may be called "Rhabdammina bottom," being the most common constituent of the bottom in several places. In the material reported upon by Goës, it occurred at *Albatross* station D3392, in 1,270 fathoms off Panama, making up the mass of the dredged material. It also occurred in 995 fathoms at station D3431, at the entrance to the Gulf of California, in great quantity. These stations give all that is known of its distribution in the North Pacific, as it has not been noted in any of the other dredged material. At these stations *Rhabdammina abyssorum* seems to be lacking.

Throughout the mass of the material few specimens were found which in any way suggested completeness of the test. Where there is a long unbranched portion at the base it is usually somewhat curved. That there may be more than the two branches is shown by the figures given here. Just what the completed specimens are can not be definitely stated with the material at hand, but a considerable size is surely indicated. There seems to be a point of weakness just above the region of forking, and the great majority of specimens are broken at that point, as shown in the figure.

### RHABDAMMINA DISCRETA H. B. Brady.

*Rhabdopleura*, species, G. M. Dawson, Can. Nat., vol. 5, 1870, p. 177, fig. 7.

*Rhabdopleura abyssorum* G. M. Dawson, Amer. Journ. Sci., vol. 1, 1871, p. 206 fig. 7; Ann. Mag. Nat. Hist., ser. 4, vol. 7, 1871, p. 86, fig. 7.

*Rhabdammina discreta* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 48; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 268, pl. 22, figs. 11–13.—Chapman, Proc. Zool. Soc. London, 1895, p. 14.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 21, pl. 1, figs. 13, 14.—Flint, Rep. U. S. Nat. Mus., 1897, (1899), p. 271, pl. 13.—Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 668.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 263, fig. 105 (in text).—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 125.

*Description.*—Test cylindrical, straight or nearly so, irregularly constricted at intervals, with the effect of divisions exteriorly but no corresponding walls within, open ends of the tube serving as apertures; wall rather thin, firmly cemented of angular sand grains, roughish on the exterior, but smoothly finished on the interior except at the constrictions, where there are various angles and irregularities; color varying with the material used in the construction of the wall.

Length indefinite, up to 25 mm.

*Distribution.*—*Rhabdammina discreta* has been found at six widely separated stations in the North Pacific. In the eastern portion it occurs at *Albatross* station D3419, in 772 fathoms, off the coast of Mexico in the material examined by Goës. Brady records its occurrence at one *Challenger* station in the western Pacific, west of the

Ladrone Islands, in 2,475 fathoms. The *Albatross* obtained this species at two stations in the 1906 cruise—D4979, in 943 fathoms, south of Honshu Island, Japan, and D5026, in 119 fathoms in the Okhotsk Sea. Bagg records the species from station H4502 in 1,342 fathoms near the Hawaiian Islands, but his specimen is a mere fragment, poorly characterized.

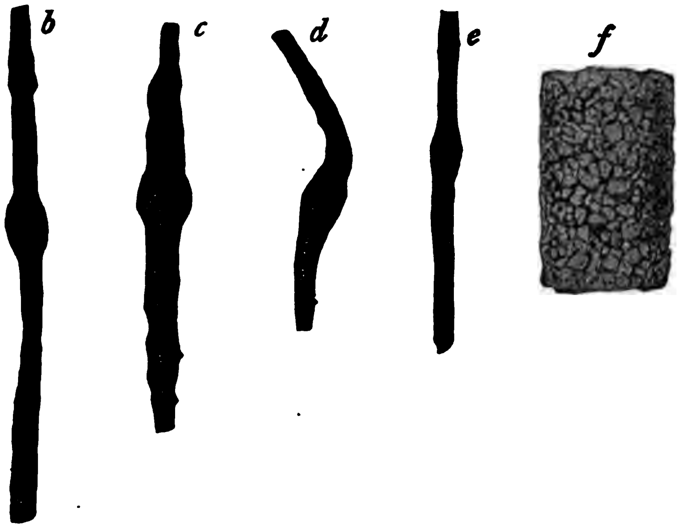
The specimen figured by Goës is not typical, but there are larger typical specimens among his mounted material from the same station. Brady speaks of the occurrence of this species usually at considerable depths, but in the far north off the coast of Greenland in 20 fathoms and in the far south off Kerguelen Island at 120 fathoms. He also gives a suggestion that the distribution may be more or less affected by the temperature of the ocean bottom. In this connection it is interesting to observe that the only North Pacific station for this species at all shallow, 119 fathoms, in the Okhotsk Sea, had a bottom temperature of 30.4° F., a low temperature even for ocean bottom conditions, colder even than the deeper stations where this species occurs.

### RHABDAMMINA LINEARIS H. B. Brady.

*Rhabdammina linearis* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 37, pl. 3, figs. 10, 11.—Bütschli, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 194, pl. 5, fig. 10.—H. B. Brady, Rep. Voy. *Challenger*, Zoology,

*ion.*—Brady records this species from the South Pacific, ıe Summary of Results" of the *Challenger* expedition it en from two stations, 237 and 246, in 1,875 and 2,050 ıe station east of Japan, the other in the middle of the fic.

al example of this species was noted in the North Pacific have examined. Two specimens from *Albatross* station



MMINA LINEARIS. *a–e*, × 10, *e*, SHOWING INTERIOR, *f*, SURFACE. × 60. (AFTER BRADY.)

437 fathoms, may possibly belong here, but the central t is not very pronounced.

### Genus MARSIPELLA Norman, 1878.

ı NORMAN (type, *M. elongata* NORMAN), Ann. Mag. Nat. Hist., ser. 5, , 1878, p. 281.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 264.

*a* W. B. CARPENTER, Proc. Roy. Soc. London, vol. 18, 1869, p. 60 (not *ᴐmina* WILLIAMSON, 1858).

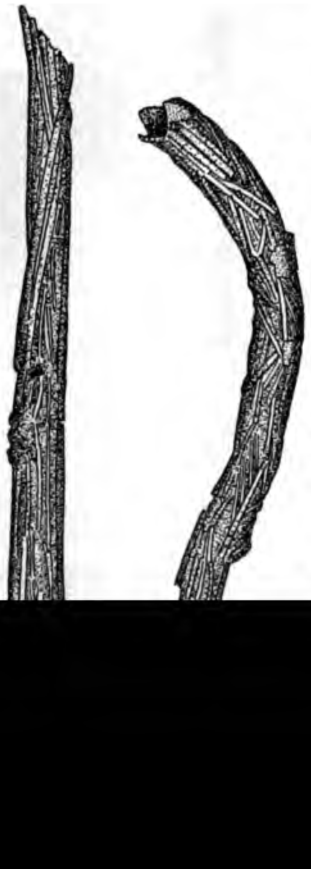
*on.*—Test free, tubular, cylindrical or fusiform, sometimes the ends, apertures formed by the open ends of the tube, sed wholly or in part of sponge spicules, thin but firmly ogether.

species has been found in the North Pacific, and that has but few stations. It has been found in the colder por- North Atlantic.

### MARSIPELLA CYLINDRICA H. B. Brady.

*Marsipella cylindrica* H. B. Brady, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 714; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 265, pl. 24, figs. 20-22.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 265, fig. 109 (in text).

*Description.*—Test tubular, slender, of nearly uniform diameter, ends of the tube open and serving as apertures, wall composed almost entirely of acicular sponge spicules, sometimes entire but usually in fragments, laid side by side, lengthwise of the test, and strongly cemented.



Length up to 7 mm.; diameter 0.12-0.25 mm.

*Distribution.*—As this genus has been recorded but once previously from the North Pacific, it is interesting to find it at four stations, but in small numbers. It has occurred off the Hawaiian Islands, *Albatross* station H3009, in 603 fathoms, rare. The other three stations are about Japan. They are, *Nero* station 1225, in 805 fathoms, south of Yokohama; *Albatross* stations D4957, in 437 fathoms, off the eastern coast of Kiushu Island, and D4900, in 139 fathoms, southwest of Nagasaki. The *Challenger* obtained it at station 237, in 1,875 fathoms, east of Japan.

what appears to be siliceous cement, wall thick in comparison with the diameter of the tube.

Two species of this genus have been found in the North Pacific, along the western coast of America, and again along the colder areas off the coast of Japan.

### BATHYSIPHON FILIFORMIS G. O. Sars.

*Bathysiphon filiformis* (M. SARS MS.) G. O. SARS, Forh. Vid. Selsk. Christiania, 1871 (1872), p. 251.—NORMAN, Rep. Brit. Ass., 1880, p. 389.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 248, pl. 26, figs. 15–20.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 16, pl. 3, figs. 39–41.—DE FOLIN, Act. Soc. Linn. Bordeaux, vol. 40, 1886, p. 279, pl. 6, figs. 4 *a–e*.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 12.—GOËS, Bull. Mus. Comp Zool., vol. 29, 1896, p. 23, pl. 1, figs. 11, 12.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 270, fig. 116 (in text).

*Description.*—Test free, cylindrical, of nearly uniform diameter, straight or somewhat curved, chamber tubular, of nearly uniform diameter, the open ends serving as the apertures; wall composed of felted sponge spicules and fine sand in varying proportions, rather soft; color light gray or white, sometimes even black, but when covered more or less by fine sand, taking on a brownish color.

Length up to 50 mm. or more; diameter up to 4 mm.

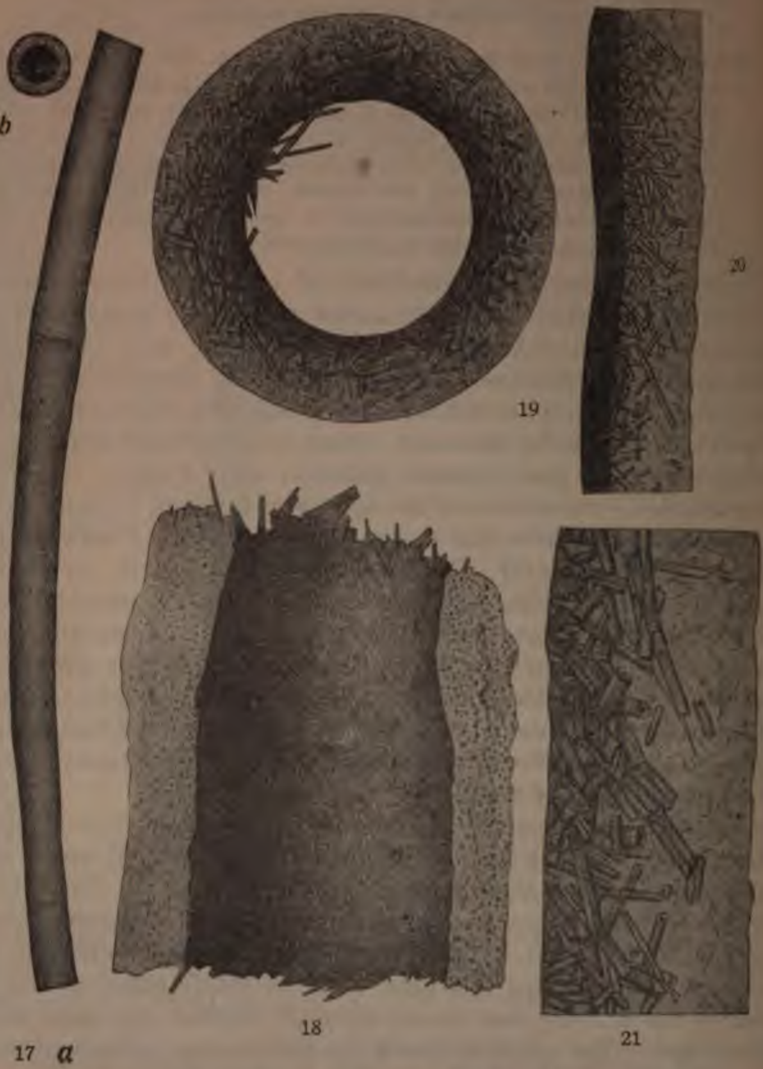
*Distribution.*—Specimens of this species were found by Goës in the *Albatross* material from the eastern tropical North Pacific at five stations, D3375, D3407, D3418, D3419, and D3431, in depths from 660–1,201 fathoms. I have examined Goës's material from Station D3419 and have found broken specimens in material from Station D3431. Later I obtained an abundance of fine long specimens from material dredged by the *Albatross* off San Diego, station D4337, 617–680 fathoms. These specimens were the best I have ever seen. The *Challenger* obtained specimens from station 237, in 1,875 fathoms, east of Japan.

Some of the specimens have a very considerable amount of arenaceous material built into the outer part of the wall, giving a very different appearance from that of typical specimens. These, however, are of the same size and shape and are associated in the material from the same station. In his list in 1896, page 92, Goës used the name, var. *arenosus* for this form with the sandy exterior, and his material has still another name, although neither was used in his original text. The constrictions of the wall are not prominent, as in the material figured by Brady.

Several fragmentary specimens were found at *Albatross* station D 5056, in 258 fathoms, in Suruga Gulf, Japan. These are somewhat smaller than the other material referred to and have a considerable range of variation in the character of the test.

### BATHYSIPHON RUFUS de Folin.

*Bathysiphon rufum* de Folin, Act. Soc. Linn. Bordeaux, vol. 40, 1886, p. 283, pl. 6, figs. 8 *a–c*.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 23, pl. 1, fig. 10.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 267, pl. 7.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 270, fig. 118 (in text).



Figs. 17–21.—Bathysiphon filiformis. 17, *a*, side view, × 4; *b*, end view, × 5. 18, longitudin section, × 60. 19, transverse section, viewed by transmitted light, × 60. 20, longitudin section of wall with exterior coat, × 60. 21, longitudinal section of inner portion of wal × 200. (Figs. 18–21. after Brady.)

*Description.*—Test free, elongate, tapering, slightly curved, surfac with many irregularly placed constrictions, smooth and polished, wa aratively thick, composed of sponge spicules and a very hard ous cement, color reddish or yellowish brown.

ngth up to 12 mm.; diameter about 0.5 mm. e broadest part.

*istribution.*—Goës records this species from three *tross* stations, D3375, D3376, in 1,201 and 1,132 oms, respectively, south of Panama, near the tor; the other, D3419, in 772 fathoms, off pulco, on the Mexican coast. I have seen erial from station D3376, consisting of eight imens selected by Goës, and one of which is here red. Specimens were also seen from station D , just south of the equator, in this same region, 85 fathoms. A single specimen was found in erial from *Alert* station 1156, 2,046 fathoms, h of the Bonin Islands.

he specimens are much more constricted than e figured by de Folin, and none of them has the small aperture or the finish shown in the larger of the original specimens figured.

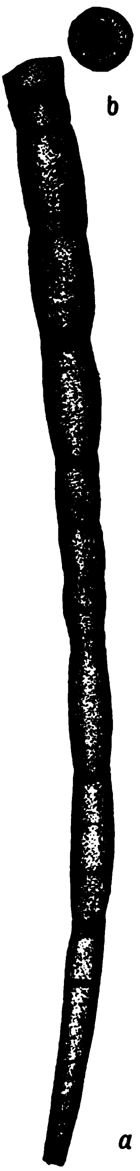


FIG. 22.—BATHYSIPHON RUFUS. × 20. *a*, SIDE VIEW; *b*, END VIEW.

## enus RHIZAMMINA H. B. Brady, 1879.

*hizammina* H. B. BRADY (type, *R. algæformis* H. B. BRADY), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 39.—BÜTSCHLI in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 195.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 274.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 252.

*arsipella* (part) EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 668.

*scription.*—Test free, consisting of a simple or otomously branching flexible tube, wall largely nous, bearing various foreign bodies attached e exterior.

t two species of this genus are known, both rring rarely in the North Pacific. The flexible acter of the wall is a distinctive feature.

### RHIZAMMINA ALGÆFORMIS H. B. Brady.

*hizammina algæformis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 39, pl. 4, figs. 16, 17; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 274, pl. 28, figs. 1-11.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 20.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 272, pl. 15, fig. 1.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 252, fig. 92 (in text).

*Description.*—Test free, consisting of a dichotomously branching flexible tube, forming tangled masses of indefinite size; wall thin, largely chitinous, but with various sorts of foreign matter attached to the exterior, either sand or other foraminiferal tests according to the character of the bottom, surface when free from foreign matter roughened, color of the chitinous tubes brown.

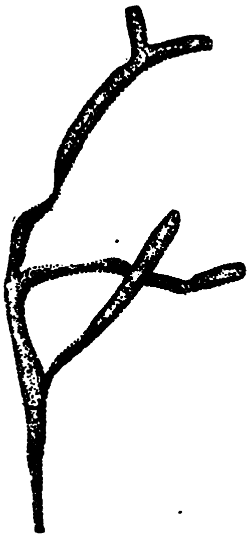


FIG. 23.—RHIZAMMINA ALGÆFORMIS. × 10.

Diameter 0.126–0.315 mm.

*Distribution.*—But four stations are known in the North Pacific for this species. Three of these are *Challenger* stations, 237, 244, 246, in 1,875, 2,900 and 2,050 fathoms, respectively; two in the middle of the North Pacific, the shallowest one east of Japan. Goës found the species at *Albatross* station D3415, off the coast of Mexico, in 1,879 fathoms. This material of Goës which I have examined is typical, without any appreciable amount of foreign material adherent to the tubes.

As the experiments of Brady show, the test is very largely made up of chitinous material with a small amount of silica in the wall.

### RHIZAMMINA INDIVISA H. B. Brady.

*Rhizammina indivisa* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 277, pl. 29, figs. 5-7.—EGGER, Abh. kön.

*Distribution.*—The only previously recorded station for this species in the North Pacific is *Albatross* station D3375 in 1,201 fathoms in globigerina ooze southwest of Panama. Goës's material consists of six specimens from this station. Some of them are not this species but belong evidently to *Pelosina cylindrica* H. B. Brady. Fragmentary material referred to this species has been noted in the samples from three *Nero* stations between Midway Island and Guam, Nos. 172, 1583, and 1678, in 2,086, 777, and 1,283 fathoms, respectively, all in globigerina ooze.

### Subfamily 2. SACCAMMININÆ.

Test consisting of a single chamber, or group of superficially attached chambers, the walls made up for the most part of agglutinated material; apertures sometimes numerous but usually single; tests free or attached.

Included here are a number of genera which seem to have certain common characters; that of a test of agglutinated material of a single chamber, usually with a single opening. The wall may be greatly varied in its constituents in the various genera, being composed of sand grains in *Proteonina*, of a single layer of sponge spicules in *Technitella*, of a felted mass of spicules in *Pilulina*, or of other tests, etc., in *Pelosina cylindrica*.

### Genus PSAMMOSPHÆRA F. E. Schulze, 1875.

*Psammosphæra* F. E. Schulze (type, *P. fusca* F. E. Schulze), II Jahr. Comm. wiss. Unt. deutsch. Meer in Kiel, 1875, p. 113.—Bütschli, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 202.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 249.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 267.—Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 598.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 241.

*Saccammina* (part) Rhumbler, Zeitschr. wiss. Zool. vol. 57, 1894, p. 462; Nachr. kön. Ges. Wiss. Göttingen, 1895, pp. 81, 82.

*Description.*—Test free or attached, usually spherical, no definite aperture, the pseudopodia making their way out between the elements of the test; wall composed of sand grains or other loose material cemented together.

Two species of this genus occur in the North Pacific, but both of them are rare and have been found at but few stations.

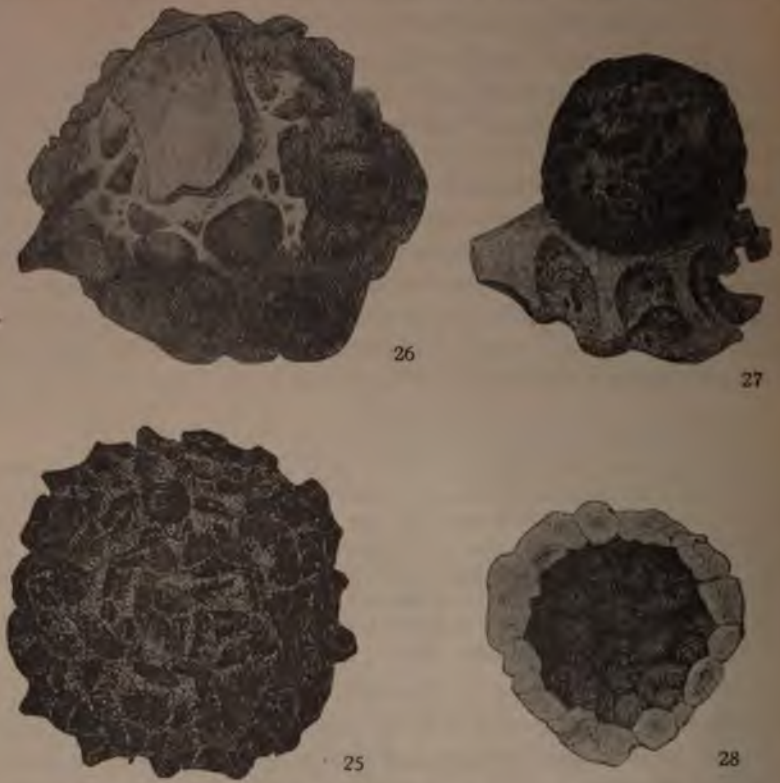
#### PSAMMOSPHÆRA FUSCA F. E. Schulze.

*Psammosphæra fusca* F. E. Schulze, II Jahr. Comm. wiss. Unt. deutsch. Meer in Kiel, 1875, p. 113, pl. 2, figs. 8 *a–f*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 249, pl. 18, figs. 1, 5–8 (not 2–4).—Goës, Kongl. Svensk. Vet. Akad. Handl, vol. 25, no. 9, 1894, p. 14, pl. 3, fig. 19.—Chapman, Proc. Zool. Soc. London, 1895, p. 13.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 268, pl. 8, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1899, p. 251.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 242, fig. 75 (in text).—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, no. 5, 1905, p. 1, pl. 1, fig. 1.

*Description.*—Test free or attached, generally spherical, no definite aperture: wall composed of a single layer of rather coarse sand grains, rather roughly put together, cement gray or brownish.

Diameter 1.5–4 mm.

*Distribution.*—Brady records this species from but two *Challenger* stations in the North Pacific, in 1,850 and 1,875 fathoms, west of the Caroline Islands, and west of Japan. Flint records it at one *Nero* station, No. 152, in 3,026 fathoms, east of Midway Island. I have specimens from two other *Nero* stations, Nos. 1153 and 1315, in 1,932 and 1,494 fathoms, near the Bonin Islands in the Western Pacific.



Figs. 25-28.—Psammosphæra fusca. 25, specimen composed of black volcanic sand, × 25. 26, free specimen, × 20. 27, attached specimen, ×40. 28, section of test, × 40. (Figs. 26-28. after Brady.)

### PSAMMOSPHÆRA PARVA Flint.

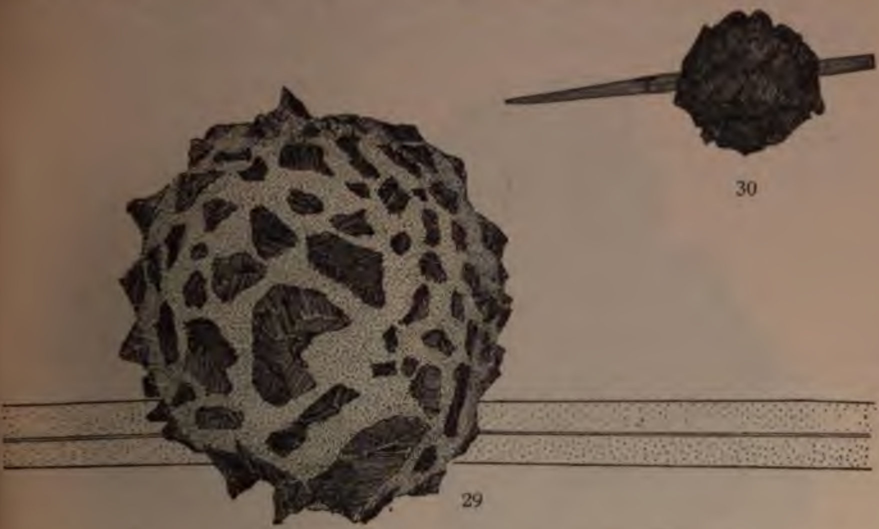
*Psammosphæra parva* Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 268, pl. 9, fig. 1.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 242, fig. 77 (in text).

*Psammosphæra fusca* (part) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 250, pl. 18, figs. 2–4 (not 1, 5–8).

*Description.*—Test free or attached, often attached to or inclosing a sponge spicule, spherical, if free, or frequently with a flattened area when attached, no definite aperture, wall thin, composed of fine sand, the particles firmly united by an abundance of cement which fills up the interstices to a large extent, color grayish or brown.

Diameter usually less than 1 mm.

*Distribution.*—Specimens which seem to be referable to this species have been noted at three stations in the North Pacific—*Albatross* station H2899 in 1,531 fathoms, east of the Hawaiian Islands, and D4979 in 943 fathoms, south of Honshu Island, Japan, also *Nero* station 1321, in 1,618 fathoms near the Bonin Islands.



FIGS. 29–30.—PSAMMOSPHÆRA PARVA. 29, SPECIMEN ATTACHED TO LARGE SPONGE SPICULE, × 50. 30, SMALLER SPECIMEN (AFTER BRADY), × 40.

There seems to be some variation in color in the specimens and the degree to which the cement fills the irregularities of the wall.

## Genus SOROSPHÆRA H. B. Brady, 1879.

*Sorosphæra* H. B. Brady (type, *S. confusa* H. B. Brady), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 28; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 251.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 235.

*Description.*—Test consisting of a colony of more or less inflated chambers, without definite apertures, the walls joined to one another, composed of sand grains with interstitial openings.

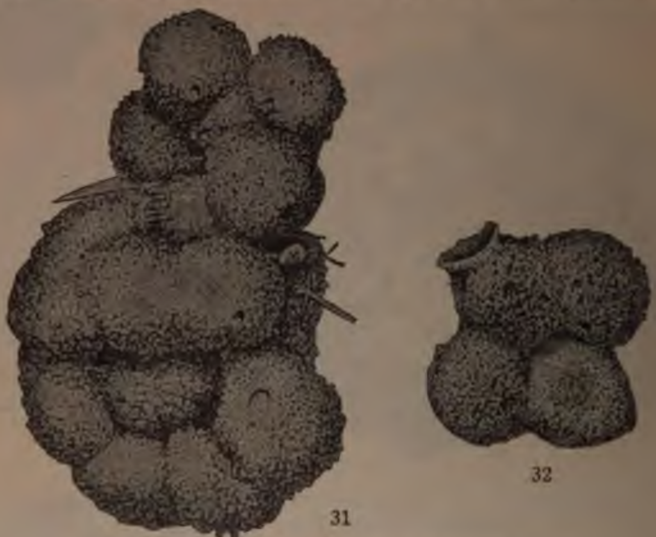
The following species has been recorded from the North Pacific by Brady:

### SOROSPHÆRA CONFUSA H. B. Brady.

*Sorosphæra confusa* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 28, pl. 4, figs. 18, 19; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 251, pl. 18, figs. 9, 10.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 235, fig. 63 (in text).

*Description.*—"Test free, consisting of a number of inflated or spherical chambers of nearly uniform size, irregularly crowded together and adhering to each other by their outer surfaces. Walls thin, finely arenaceous in texture, with minute interstitial orifices. General aperture wanting. Diameter of individual chambers about one-twenty-fifth of an inch (1 mm.), of the entire colony, variable, sometimes one-sixth of an inch (4.5 mm.)."

*Distribution.*—Brady records this species at one *Challenger* station, 244, in the middle of the North Pacific in 2,900 fathoms. In the volume on "Summary of Results" this species is also given as occurring at station 246, in 2,050 fathoms. This station is also in mid-ocean.



FIGS. 31-32.—SOROSPHÆRA CONFUSA. × 15 (AFTER BRADY).

The species has not been noted in any of the *Albatross* or *Nero* material I have examined from the North Pacific. The above description and figure 8 are from Brady.

### Genus SACCAMMINA Carpenter, 1869.

*Saccammina* (M. Sars type, *S. sphærica* G. O. Sars, Forh. Vid. Selsk. Christiania, 1868 (1869), p. 248) [*nomen nudum*].—Carpenter, Ann Mag. Nat. Hist., ser. 4, vol. 4, 1869, p. 289.—Bütschli, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 195.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 252.—Rhumbler, Zeitschr. wiss. Zool., vol. 57, 1894, p. 462.—Eimer and Fickert (part), Zeitschr. wiss. Zool., vol. 65, 1899, p. 671.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 242.

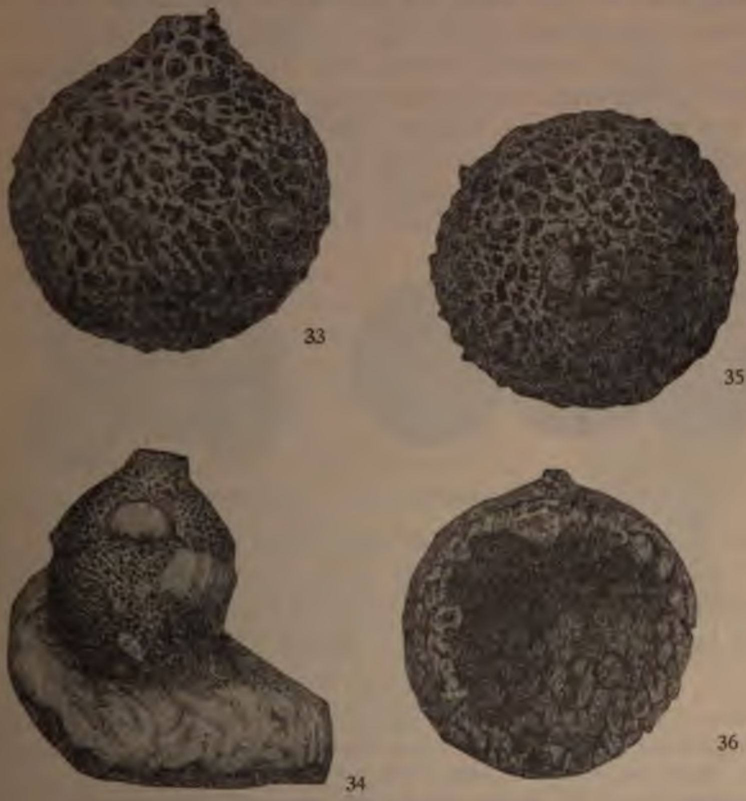
*Description.*—Test free, or sometimes attached, of one or several spherical chambers with distinct apertures, usually one for each chamber, wall composed of sand grains attached firmly to one another by a yellowish or brownish cement.

Two species of *Saccammina* occur in the North Pacific. The first of these, *S. sphærica*, has been found at numerous stations in the colder waters, but the other species, *S. socialis*, seems to be very rare.

### SACCAMMINA SPHÆRICA G. O. Sars.

*Saccammina sphærica* (M. SARS, Forh. Vid. Selsk. Christiania, 1868 (1869), p. 248, *nomen nudum*), G. O. SARS, Forh. Vid. Selsk. Christiania, 1871, p. 250.—CARPENTER, The Microscope, 5th ed., 1875, p. 532, fig. 272*a–c*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 253, pl. 18, figs. 11–17.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 254, pl. 4, fig. 8.—RHUMBLER, Zeitschr. wiss. Zool., vol. 57, 1894, pp. 433–619, pls. 21–25.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 13, pl. 3, figs. 16–18.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 13.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 26.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 269, pl. 9, fig. 2.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 243, figs. 78*a–d* (in text).

*Description.*—Test free, rarely attached, spherical or pyriform; typically of a single chamber with a single aperture at the end of a slightly projecting portion of the test; wall composed of fairly coarse sand grains, firmly cemented; color various, gray to almost black, occasionally brownish or reddish.



FIGS. 33-36.—SACCAMMINA SPHÆRICA. × 15 (AFTER BRADY). 33, FREE SPECIMEN. 34, ATTACHED SPECIMEN. 35, APERTURAL VIEW. 36, SECTION.

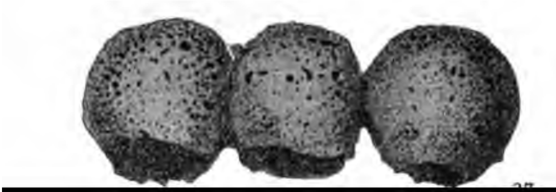
Diameter 1–3.5 mm.

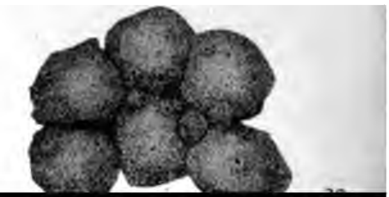
*Distribution.*—This species appears to be fairly well distributed in the North Pacific in the colder waters. The *Challenger* dredged specimens at station 246 in 2,050 fathoms in the middle of the North Pacific. Goës records it from three *Albatross* stations off the coast of Mexico in 660–995 fathoms. His selected material which I have seen, from the entrance to the Gulf of California, is very large and more like the typical Arctic material. I have found the species in material in 2,085 fathoms, *Albatross* station H2833, midway between San Francisco and the Hawaiian Islands; also from several stations south of Japan in the colder water, in 139–1,551 fathoms.

### SACCAMMINA SOCIALIS H. B. Brady.

*Saccammina socialis* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 255, pl. 18, figs. 18, 19.—Chapman, Proc. Zool. Soc. London, 1895, p. 13.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 244, fig. 79 (in text).

*Description.*—"Test consisting of several independent arenaceous chambers, individually spherical or subspherical in shape and of nearly even size, attached to each other by their outer surfaces, but without stoloniferous intercommunication, each chamber having its own external aperture. Spheres seldom more than six or eight in number, and usually arranged with more or less regularity. Texture finely sandy, nearly smooth externally. Diameter of the individual chambers, one-thirtieth of an inch (0.8 mm.) or less."





grains or other foreign matter, test usually broadest near the base and gradually tapering more or less evenly to the apertural end.

Several species of *Proteonina* occur in the North Pacific, certain of the species apparently confined to specific regions as far as the material is able to indicate.

### PROTEONINA FUSIFORMIS Williamson.

*Proteonina fusiformis* Williamson, Recent Foraminifera of Great Britain, 1858, p. 1, pl. 1, fig. 1.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 248, fig. 84 (in text).

*Reophax fusiformis* H. B. Brady, Denkschr. kais. Akad. Wiss. Wien, vol. 43, pt. 2, 1882, p. 99; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 290, pl. 30, figs. 7-11.—Millett, Journ. Roy. Micr. Soc., 1899, p. 253, pl. 4, fig. 11.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 125.

*Lituola fusiformis* J. Wright, Rep. Belfast Club, 1876-77, Append., table.

*Lituola nautiloidea*, var. *scorpiurus* W. B. Carpenter, in Parker and Jones, Intr., Study Foram. 1862, Append., p. 309.

*Description.*—Test free, fusiform, asymmetrical, chamber either single or somewhat incompletely divided, walls composed of fairly coarse sand grains, rough externally, but closely cemented, aperture terminal, single.

Length 0.63-1.0 mm. or more.

*Distribution.*—This species does not seem to be common in the North Pacific, but four stations being known. The *Challenger* found it near the Philippines, Station 209, 95 fathoms. Doctor Bagg records it from the Hawaiian Islands, *Albatross* station H4585, 689 fathoms. It has also been noted from two *Nero* stations in the vicinity of the Bonin Islands, in 1,415 and 1,543 fathoms.

Specimens of this species are always more or less irregular in form, but the general character of Williamson's figure is readily distinguished in the specimens.

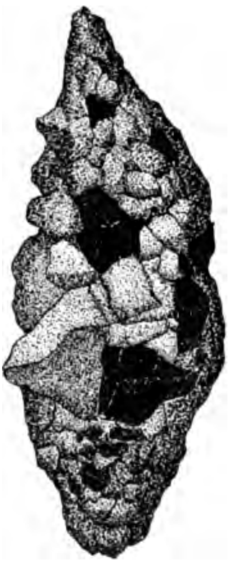


FIG. 39.—PROTEONINA FUSIFORMIS. × 75.

### PROTEONINA DIFFLUGIFORMIS (H. B. Brady).

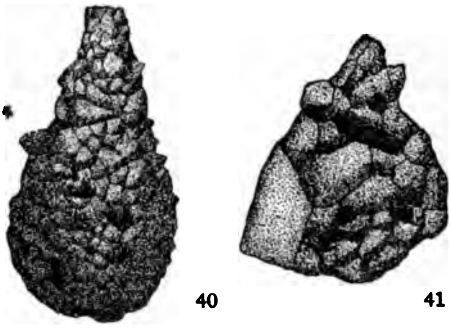
*Reophax difflugiformis* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 51, pl. 4, figs. 3 *a*, *b*; Denkschr. kais. Akad. Wiss. Wien, vol. 43, pt. 2, 1882, p. 99; Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 715; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 289, pl. 30, figs. 2-4 (not 1, 5).—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 26, pl. 6, figs, 196-198; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 28.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 272, pl. 16, fig. 2.—Millett, Journ. Roy. Micr. Soc., 1899, p. 252.

*Saccammina difflugiformis* Eimer and Fickert, Zeitschr. wiss. Zool., vol 65, 1899, p. 671.

*Proteonina difflugiformis* Rhumbler, Arch. Protistk., vol. 3, 1903, p. 245, figs. 80 *a*, *b*, (in text).

*Description.*—Test free, consisting of a single elongate oval o pyriform chamber, with a more or less distinct tubular neck; chambe undivided; wall fairly thick, composed of closely cemented sand grains of variable size and roughness; aperture simple, terminal; color, varying with the material of the wall.

Length 0.36–0.75 mm.



FIGS. 40–41.—PROTEONINA DIFFLUGIFORMIS. 40, A TYPICAL ELONGATE SPECIMEN OF FINE SAND GRAINS. × 80. 41, AN IRREGULAR SPECIMEN WITH LARGER SAND GRAINS, THE LARGE FRAGMENTS AT THE LEFT CAUSING A DISTORTION OF THE OUTLINE OF THE TEST. × 50.

*Distribution.*—The various records for this species are all in rather cold or deep water as far as the North Pacific is concerned. Brady records it in the deep water of the Northwest Pacific, in 2,300–3,950 fathoms. Goës found the species in material from off the west coast of Mexico and southwest of Panama, *Albatross* stations D3415 and 3376 in 1,879 and 1,132 fathoms respectively. I have examined Goës's material from the latter station.

Specimens referable to this species have been found in the *Albatross* material from the Northwest Pacific, stations D4957, D4979, and D5095, in 437, 943, and 58 fathoms, respectively. These stations are in the cold area off the southeast coast of Japan.

### PROTEONINA OVATA, new species.

*Description.*—Test free, ovate in side view, nearly circular in end view, wall thick, composed of neatly cemented and fairly large sand grains, apertural end abruptly contracted to form a short, tapering neck with the very small aperture at its extremity; color light yellowish or brownish gray; fairly large

Length about 1.25 mm.; diameter about 0.6 mm.

*Distribution.*—Specimens of this species have been seen in material from but two stations, *Albatross* H3007, in 323 fathoms, and Nero station 2071, in 271 fathoms, both near the Hawaiian Islands.

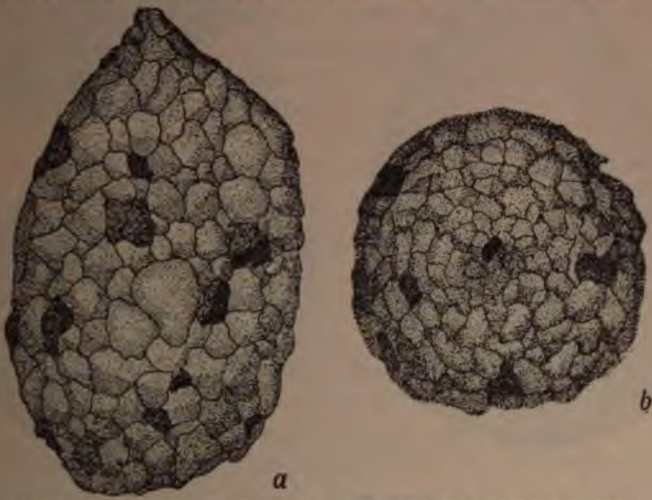


FIG. 43.—PROTEONINA OVATA. × 50. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

*Type-specimen.*—Cat. No. 8264, U.S.N.M., from *Nero* station 2071.

The species is a fairly large one. The form, abrupt contraction of the neck with the very small aperture, will at once distinguish this from other described species.

## Genus PILULINA W. B. Carpenter.

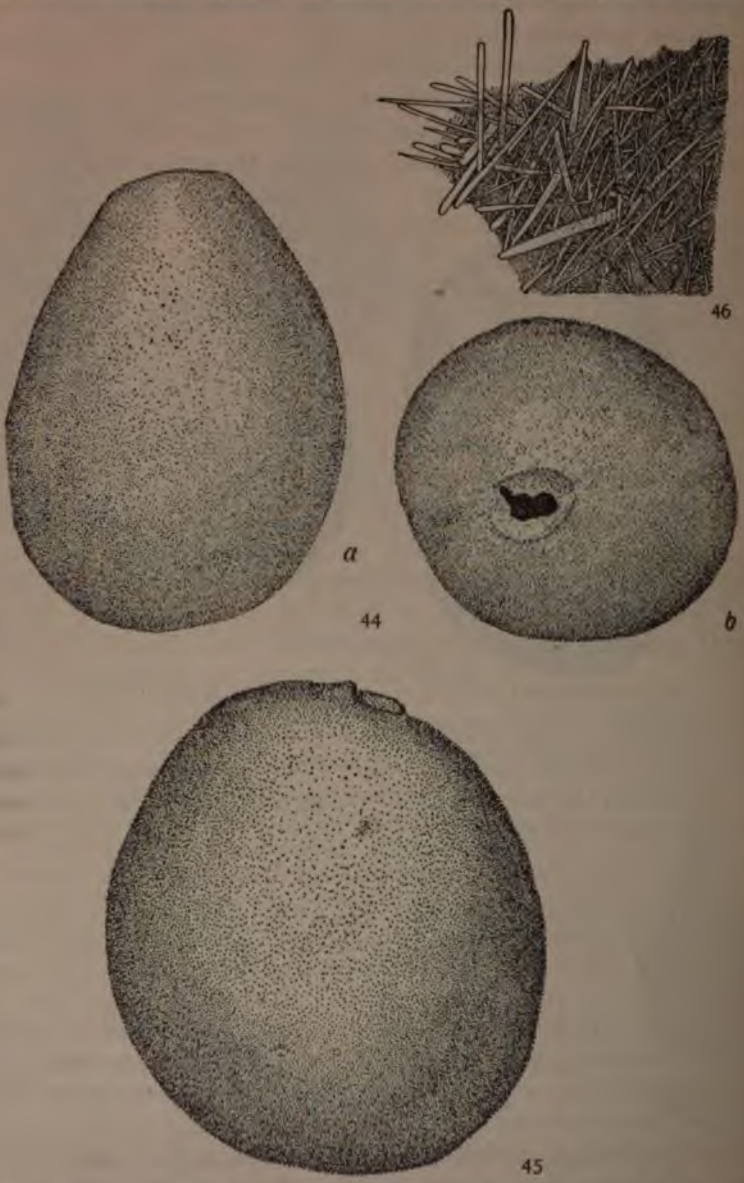
*Pilulina* W. B. CARPENTER, (type, *P. jeffreysii* W. B. CARPENTER.) Descr. Cat. Objects Deep-Sea Dredging [1870], p. 5.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 244.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 249.

*Description.*—Test free, globular or ovate, consisting of a single undivided chamber, wall composed of felted sponge spicules and a slight amount of fine sand without cement, aperture elongate, with a somewhat depressed area about it.

A single species was described by Carpenter from the North Atlantic. A new species has been found in material dredged by the fisheries steamer *Albatross* north of Japan differing in certain characters from the species described by Carpenter. The wall of these species is rather unique, as no cement seems to be used, the long spicules being felted together into a thin wall.

### PILULINA OVATA, new species.

*Description.*—Test ovate in side view, broadly elliptical or nearly circular when viewed from the apertural end; walls very thin, smooth, composed of felted sponge spicules and fine amorphous material;



FIGS. 44–46.—PILULINA OVATA. 44, *a*, SIDE VIEW OF ONE OF THE SMALL SPECIMENS, × 20; *b*, SAME FROM THE APERTURAL END. 45, A LARGE SPECIMEN FROM THE SIDE. × 12. 46, A PORTION OF THE WALL BY TRANSMITTED LIGHT. × 100.

rregular in shape, elongate, situated in an oval depression
ller end of the test; color white.
specimens 5 mm. in length; 3 mm. in diameter.
*tion.*—A number of specimens of this species were obtained
heries steamer *Albatross* on the 1906 cruise in the North-
ific. They are from station D5056, in 258 fathoms, in
ulf, Japan.
*ecimen.*—Cat. No. 8257, U.S.N.M., from the above station.
ecies differs from *Pilulina jeffreysii* Carpenter in its gen-
in its very thin walls, and in the character of its aperture.
long to a new genus as it differs in characters of rather more
ific importance. *Pilulina jeffreysii* is only known from the
lantic and this species is widely separated geographically
by distinctive characters.

### Genus PELOSINA H. B. Brady, 1879.

H. B. Brady (type, *P. variabilis* H. B. Brady), Quart. Journ. Micr. Sci.,
. 19, 1879, p. 30.—Bütschli, in Bronns Klassen und Ordnungen des Thier-
hs, vol. 1, 1880, p. 194.—H. B. Brady, Rep. Voy. *Challenger*, Zoology,
. 9, 1884, p. 235.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 238.

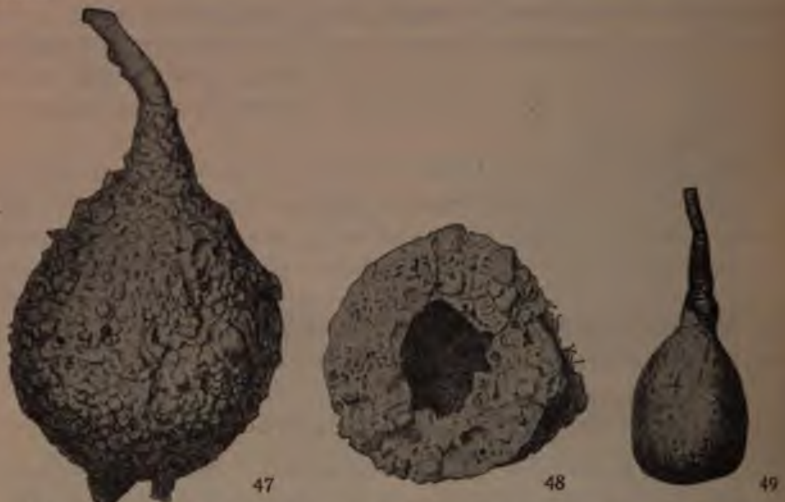
*tion.*—Test free, variously formed, rounded, cylindrical or
elongate; wall usually thick, composed of mud with a
basal layer, exterior often with various foreign bodies in-
the test; aperture typically single and terminal.
pecies of *Pelosina* are known from the North Pacific, but all
eem to be rare, and for the most part they occur in deep

#### PELOSINA ROTUNDATA H. B. Brady.

*rotundata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 31,
3, figs. 4, 5; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 236, pl. 25, figs.
20.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 254,
11, fig. 60.—Millett, Journ. Roy. Micr. Soc., 1899, p. 249, pl. 1, fig. 1.—
umbler, Arch. Protistk., vol. 3, 1903, p. 239, fig. 71 (in text).

*tion.*—Test flask-shaped or pyriform with an elongated
ck, at the end of which is the aperture; wall thick, composed
nd the tests of other Foraminifera, *Globigernia*, etc., with
ent, the tubular neck membranaceous, interior consisting of
divided chamber, small; color grayish white.
er 1.8 mm.
*tion.*—The *Challenger* dredged this species at station 246,
thoms in the middle of the North Pacific. This is the only
this area, although it was found by Millett in material from

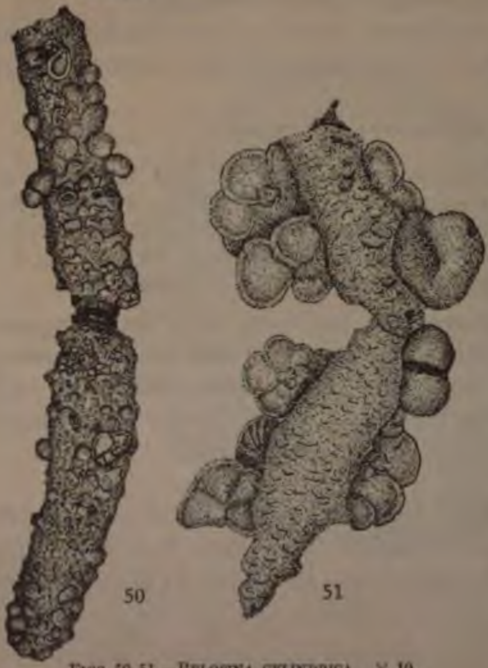
the Malay Archipelago. It has usually been found in rather deep water.



Figs. 47-49.—Pelosina rotundata. × 20 (after Brady). 48, transverse section.

### PELOSINA CYLINDRICA H. B. Brady.

*Pelosina cylindrica* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 236, pl. 26, figs. 1-6.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 253, pl. 4, figs. 1, 2.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 239, fig. 72 (in text).



Figs. 50-51.—Pelosina cylindrica. × 10.

*Description.*—Test elongate, cylindrical, straight or slightly curved, of nearly uniform diameter, ends rounded, aperture at one end, circular; wall thick, composed of loosely aggregated shell fragments or foraminiferal tests with a mud base, outside irregular, rough, interior smoothly finished, interior chitinous; color dark gray, but varying much according to the constituents of the test, being almost white when many foraminiferal tests are included in the wall.

Length up to 12 mm.; diameter about 2 mm.

*Distribution.*—The *Challenger* expedition obtained *this species* at three North Pacific stations, 237, 244, 246, in

fathoms. These stations are in the deep portion of
Pacific, the first of the stations off the east coast of

*Albatross* material I have seen which may be referred to
is a portion of the specimens selected by Goës from *Alba-*
D3375, in 1,201 fathoms, in the eastern tropical Pacific.
all called by Goës *Rhizammina indivisa*, but some of them
elong here.

### PELOSINA VARIABILIS H. B. Brady.

*riabilis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 30, pl.
1-3; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 235, pl. 26, figs. 7-9.—
Rep. U. S. Nat. Mus., 1897 (1899), p. 266, pl. 4, fig. 1.—RHUMBLER,
Protistk., vol. 3, 1903, p. 239, fig. 74 (in text).

*n.*—Test consisting of a single fusiform chamber, or of
e independent
rregularly as-
usually at the
d of the first
ll thick, com-
ud and some
ticles loosely
the basal layer
ous, apertural
hat extended
lar neck, the
h is membran-
s end a circu-
e, chamber
rming to the
e test; color

at widest por-
2 mm., length

*n.*—In the
c this species
y from a single
tation, 246, in 2,050 fathoms, situated in the deep por-
iddle part of the North Pacific.

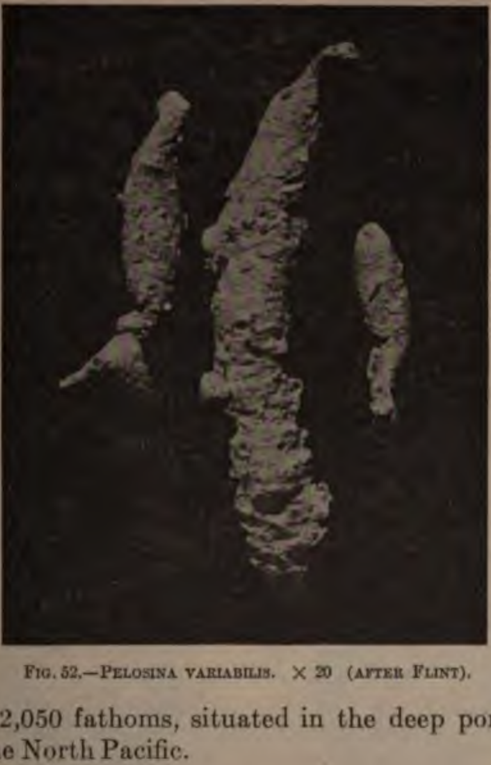


FIG. 52.—PELOSINA VARIABILIS. × 20 (AFTER FLINT).

## Genus TECHNITELLA Norman, 1878.

NORMAN (type, *T. legumen* NORMAN), Ann. Mag. Nat. Hist., ser. 5,
1878, p. 279.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9,
p. 245.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 256.

*n.*—Test free, usually elongate, subcylindrical, fusiform
oval, interior consisting of a single chamber; wall thin,

composed of sponge spicules and fine sand, aperture rounded, single, at one end of the test.

Two species of *Technitella* are known from the North Pacific, and they both seem to be very rare. The genus is at once distinguished by the elongate arrangement of the sponge spicules in the direction of the long axis of the test.

### TECHNITELLA LEGUMEN Norman.

*Technitella legumen* NORMAN, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 279, pl. 16, figs. 3, 4.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 246, pl. 25, figs. 8-12.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 14, pl. 3, figs. 20-27.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 251, pl. 4, fig. 4.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 256, fig. 96 (in text).

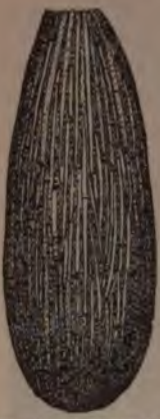


FIG. 53.—TECHNITELLA LEGUMEN. × 50.

*Description.*—Test subcylindrical, frequently somewhat curved, apertural end rounded or sometimes with a short tubular neck, aboral end rounded or sometimes bluntly pointed; wall composed of sponge spicules and sand grains, aperture rounded; color of test white or grayish white, sometimes with a coating of sand.

Length up to 2.5 mm.

*Distribution.*—Known from station 237 of the *Challenger* expedition, east of Japan, in 1,875 fathoms.

### TECHNITELLA MELO Norman.

*Technitella melo* NORMAN, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 280, pl. 16, figs. 5, 6.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 246, pl. 25, figs. 7 *a*, *b*.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 12.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 256, figs. 95 *a*, *b* (in text).

*Description.*—Test oval, being slightly tapering at the ends, aperture small, usually circular, at one end of the test; wall composed almost entirely of long sponge spicules arranged lengthwise of the test firmly united with a white cement; color white or grayish white.

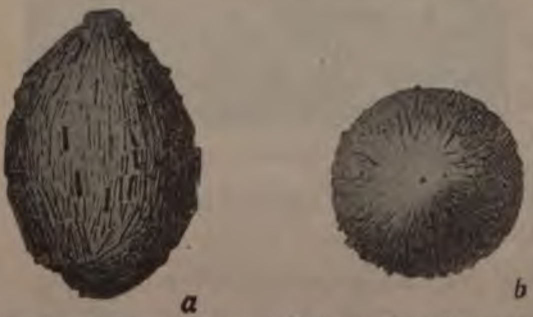


FIG. 54.—TECHNITELLA MELO. × 50 (AFTER BRADY). *a*, SIDE VIEW; *b*, APERTURAL VIEW.

Length, 1.4 mm.; diameter, 1.0 mm.

*Distribution.*—There is but the one North Pacific *Challenger* record for this species, station 237, east of Japan, in 1,875 fathoms.

## Genus THOLOSINA Rhumbler, 1895.

*Placopsilina* H. B. Brady (part), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 51; vol. 21, 1881, p. 51; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 314.

*Tholosina* Rhumbler, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 82; Arch. Protistk., vol. 3, 1903, p. 226.

*Pseudoplacopsilina* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 672.

*Description.*—Test attached, hemispherical, flattened on the side by which it is attached, chamber single, undivided; walls fairly thick, composed of sand grains with a large proportion of calcareous cement, walls roughened on the exterior.

The single species of this genus has been found but rarely in the North Pacific. It is easily distinguished when it is attached to dark colored tests like *Rhabdammina*, as its white color shows up strikingly against the darker background.

Rhumbler seems to be quite right in making a new genus for this species, which is quite different from the genus to which it has usually been assigned. The name proposed by Eimer and Fickert will have to go into the synonymy and the earlier name proposed by Rhumbler will stand.

### THOLOSINA BULLA (H. B. Brady).

*Placopsilina bulla* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 51; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 315, pl. 35, figs. 16, 17.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 28, pl. 6, figs. 213–215 (not figs. 211, 212=*Ammolagena*); Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 25.—Millett, Journ. Roy. Micr. Soc., 1899, p. 361, pl. 5, fig. 11.

*Tholosina bulla* Rhumbler, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 82.—Kiær, Norske Nordhavs-Exp., No. 25, 1899, p. 4.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 227, fig. 52 (in text).

*Pseudoplacopsilina bulla* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 672.

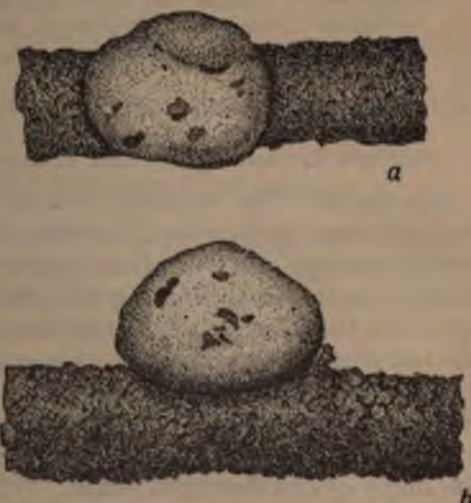


Fig. 55.—Tholosina bulla. × 15. *a*, from above; *b*, from side.

*Description.*—Test adherent hemispherical or strongly convex, flattened at the base to conform to the surface to which it is attached, usually slightly longer in one direction than the other; chamber single, usually undivided, walls thick, composed of sand grains with an excess of calcareous cement, surface uneven, apertures simple, nearly circular, usually two in number, situated at either end near the base; color grayish white.

Diameter 0.5–1.0 mm.

*Distribution.*—The only published records for this species in the North Pacific are those of Goës, *Albatross* station D3399, in 1,740 fathoms off Panama and station D3419, in 772 fathoms off the west coast of Mexico. I have examined the material selected by Goës, consisting of five specimens attached to *Rhabdammina* and *Saccammina*. One of these specimens is figured here. This shows a slight tendency toward division as do certain other specimens. Goës[a] shows a longitudinal section of a specimen indicating a division into three chamberlets. Figures 211 and 212 referred to this species by Goës are really *Webbinella hemisphærica* (Jones, Parker, and H. B. Brady).

I have found a single specimen from Blake Reef, south of Japan, *Albatross* station H4881, 316 fathoms, which seems to be an immature specimen of this species. It is attached to a fragment of shell, slightly less convex than larger specimens, but otherwise similar. Another single specimen was found from *Albatross* station D5056, in 258 fathoms on the east coast of Japan, attached to a specimen of *Bathysiphon filiformis*. A third single specimen is from D4979 off Japan attached to a specimen of *Rhabdammina*.

## Genus WEBBINELLA Rhumbler, 1903.

*Webbina* JONES, PARKER, and H. B. BRADY, Pal. Soc. Monogr., 1865, p. 27 (not

### WEBBINELLA HEMISPHÆRICA (Jones, Parker, and H. B. Brady).

*Webbina hemisphærica* JONES, PARKER, and H. B. BRADY, Pal. Soc. Monogr.. 1865, p. 27, pl. 4, fig. 5.—ROBERTSON, Rep. Brit. Ass., 1875, p. 189.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 350, pl. 41, fig. 11.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 266, pl. 14, figs. 1-3.—CUSHMAN, Proc. Boston Soc. Nat. Hist., vol. 34, 1908, p. 24.

*Placopsilina bulla* GOËS (part), Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 28, pl. 6, figs. 211, 212 (not figs. 213-215).

*Psammosphæra hemisphærica* EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 671.

*Webbinella hemisphærica* RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 228, fig. 54 (in text).

*Description.*—Test adherent, circular in outline when seen from above, central portion convex, surrounded by a flattened border of varying width, chamber single, undivided, wall composed of sand grains with much cement, nearly smooth outside, more or less roughened within; aperture not visible, the region of attachment serving for the egress of the pseudopodia about its edge; color grayish-white or brownish. Diameter 0.5–1.5 mm.

*Distribution.*—The two specimens which I have found in the *Albatross* material from the Northwest Pacific are the only records for this region. Single specimens attached to shell fragments were found, one at *Albatross* station D4874, in 66 fathoms in Korea Strait, near Japan, the other at D4900, in 139 fathoms in the Eastern Sea of Japan.

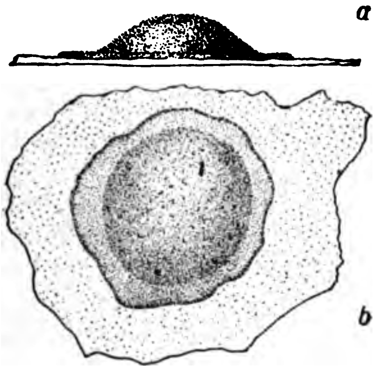


FIG. 56.—WEBBINELLA HEMISPHÆRICA, ATTACHED TO A FRAGMENT OF SHELL, × 50. *a*, FROM SIDE; *b*, FROM ABOVE.

## Genus AMMOSPHÆROIDES, new genus.

*Description.*—Test irregularly subglobular, composed of an elongate or subspherical chamber with double apertures typically; wall finely arenaceous with a large proportion of reddish-brown cement, apertures at the end of short tubular portions of the test.

*Type of the genus.*—*Ammosphæroides distoma*, new species.

The peculiar rusty appearance of the test and the double apertures at once separate this from any allied arenaceous forms.

### AMMOSPHÆROIDES DISTOMA, new species.

*Description.*—Test irregular, subglobular or with deep depressions of the surface, irregularly made up of two portions, each of which possesses an aperture; wall finely arenaceous, the outer portion flaking off when specimens are dried, fairly smooth, with an abundance of cement of a dark reddish-brown color; apertures at the end of very short tubular necks, irregular or nearly circular in section; color ferruginous, due to the dark reddish-brown color of the cement.

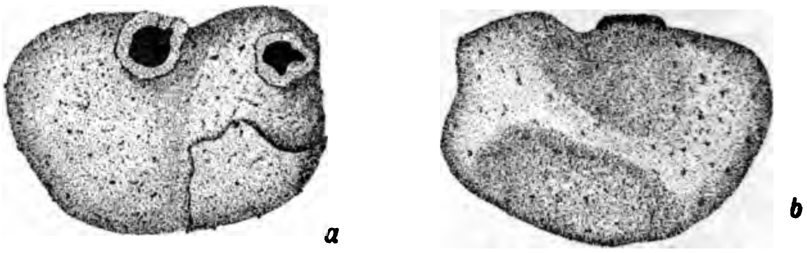


FIG. 57.—AMMOSPHÆROIDES DISTOMA. × 50. *a*, APERTURAL VIEW; *b*, FROM SIDE.

Diameter 0.4–0.8 mm.

*Distribution.*—Specimens of this species were fairly common at one *Albatross* station, D5018, in the sea of Okhotsk off the southern end of the eastern coast of Sakhalin Island, in 82 fathoms.

*Type-specimen.*—No. 8258, U.S.N.M., from the above station.

### Genus VERRUCINA Goës, 1896.

*Verrucina* Goës (type, *V. rudis* Goës), Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 25.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 232.

*Description.*—Test adherent, irregular-ovoid in shape; interior divided into irregular chamberlets, wall composed of sand grains, rough externally, aperture usually double, situated in the depressed area at the center of the dorsal side the length of the base. With this exception the characters seem to be rather constant in the specimens examined.

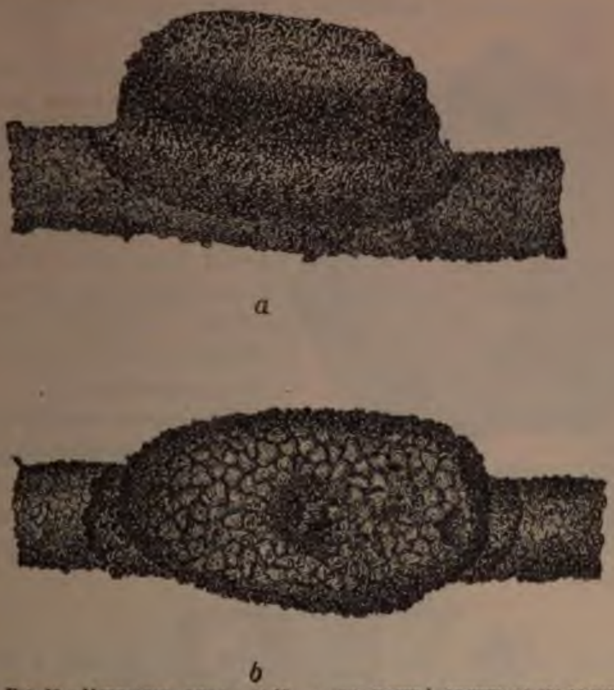


FIG. 58.—VERRUCINA RUDIS. × 10. *a*, SIDE VIEW; *b*, VIEWED FROM ABOVE.

## Genus CRITHIONINA Goës, 1894.

*Crithionina* Goës (type, *C. mamilla* Goës) Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 14; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 24.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 229.

*Description.*—Test spherical, lenticular, or variously shaped, interior either labyrinthic or with a single chamber, apertures small and scattered or indistinct, wall thick, composed of sponge spicules or very fine sand, often chalky in appearance.

This genus which has a considerable development in the Arctic and North Atlantic oceans seems to find similar conditions off the western coast of North America where several species occur. They seem in most cases to be specifically distinct from the Atlantic and Arctic forms. Four species occur off the west coast of America.

### CRITHIONINA RUGOSA Goës.

*Crithionina rugosa* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 24, pl. 2, figs. 3, 4.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 232, fig. 59 (in text).

*Crithionina abyssorum* (part) Kiær, Norske Nordhavs-Exp., no. 25, 1899, p. 7, pl. 1, fig. 4 (not 1–3).

*Description.*—"Subglobular, with coarsely tuberculated surface; wall thick, obsoletely cavernous, the chamber somewhat irregular, showing faint traces of subdivision; color gray or whitish; the consistency of the shell is usually loose, the texture being finely arenaceous, with a large portion of shell débris. Diameter 1-2 mm."

*Distribution.*—Goës found and described this species from material from two *Albatross* stations D3415, in 1,879 fathoms off the west coast of Mexico and D3407, in 885 fathoms, near the Galapagos Islands.

The above description is copied from that of Goës. His specimens from the first of the two stations I have examined. There are six, rather poorly characterized specimens, more irregular than his figure. One of these specimens is figured here.

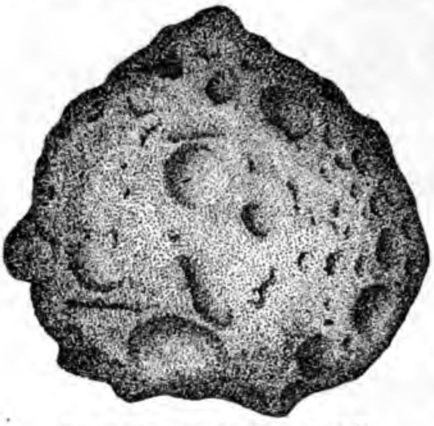


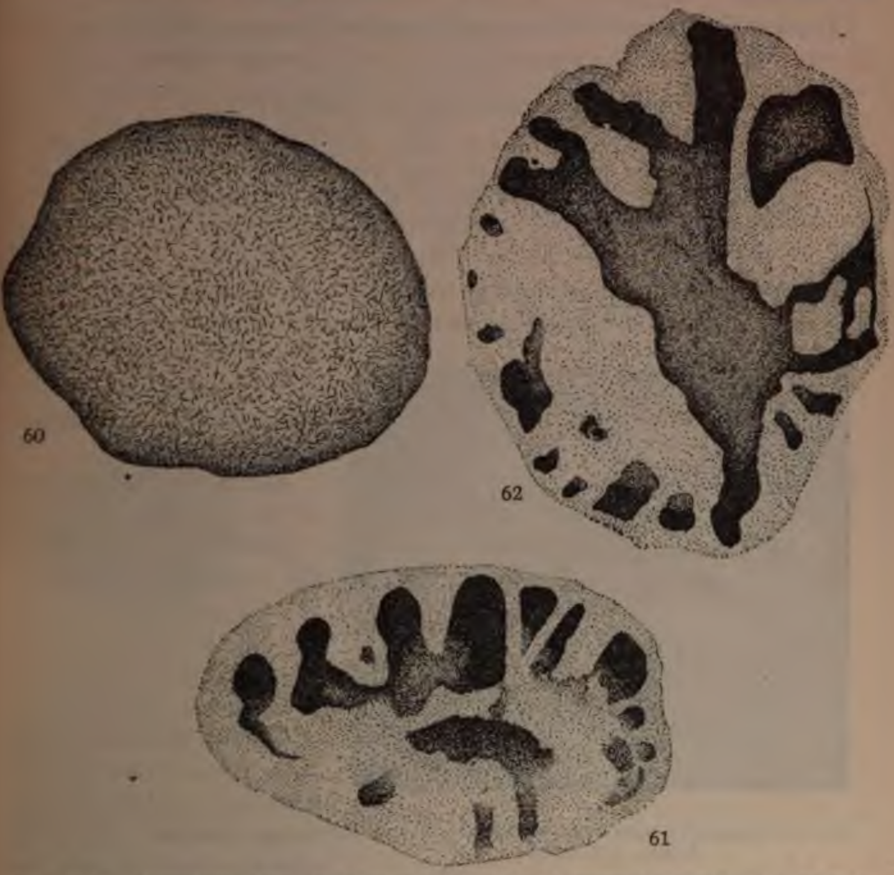
FIG. 59.—CRITHIONINA RUGOSA. × 20.

### CRITHIONINA LENS Goës.

*Crithionina lens* GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 24, pl. 2, figs. 5-8.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 232, fig. 60 (in text).

*Description.*—Test flattened, orbicular, elliptical or irregular in

A number of specimens selected by Goës have been examined, and I fail to find any such regularity in the divisions as shown by Goës's figures. In the accompanying figures are given two sections from Goës's material from station D3419.



FIGS. 60-62.—CRITHIONINA LENS. 60, SURFACE VIEW. × 15. 61, VERTICAL SECTION. × 20. 62, HORIZONTAL SECTION. × 20.

### CRITHIONINA PISUM Goës.

*Crithionina pisum* GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 24, pl. 2, figs. 1, 2.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 250, pl. 4, fig. 3.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 266, pl. 6, fig. 1.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 242, fig. 57 (in text).

*Crithionina abyssorum* (part) KLÆR, Norske Nordhavs-Exp., no. 25, 1899, p. 7, pl. 1, fig. 2 (not 1, 3, 4).

*Description.*—Test free, globular in typical form but variable, surface even, wall rather thick, soft, composed of loosely-matted sand

and sponge spicules, interior chamber single, undivided, apertures interstitial; color grayish white.

Diameter 1–3 mm.

The typical form of this species has not been recorded from the North Pacific, but it is represented by the following variety:

### CRITHIONINA PISUM Goës, var. HISPIDA Flint.

*Crithionina pisum* Goës, var. *hispida* Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 267, pl. 6, fig. 2.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 230, fig. 61 (in text).—[?] Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 127.

*Crithionina abyssorum* (part) Kiær, Norske Nordhavs-Exp., no. 25, 1899, p. 7, pl. 1, figs. 1, 3 (not 2, 4).

*Description.*—Variety differing from the typical in its smaller size and the hispid surface made up of a great number of sponge spicules arranged nearly perpendicular to the outer wall; walls somewhat thinner than in the typical.

About one-half the size of the typical form.

*Distribution.*—One of the original stations for Flint's material was in the North Pacific, *Albatross* station D3080, in 93 fathoms, green mud, off Hecata Bank, Oregon. Bagg records the variety from two *Albatross* stations, H4440, in 1,259 fathoms, and H4502, in 1,342 fathoms, both stations in the vicinity of the Hawaiian Islands. I have failed to find this variety in any of the western Pacific material that I have examined.

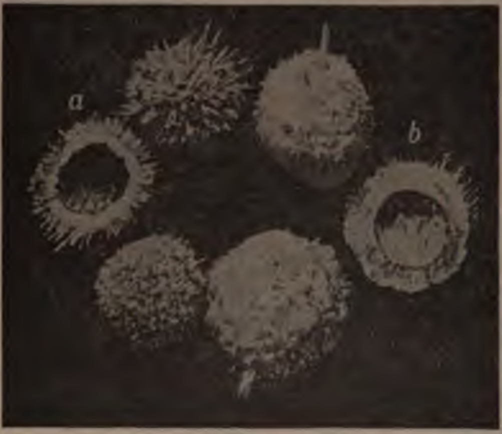


Fig. 63.—Crithionina pisum, var. hispida. × 15 (after Flint). *a*, *b*, sections.

The specimens from *Albatross* station H4502 in the National Museum labeled as this variety by Doctor Bagg seem to me to be very small spinose Radiolaria and not Foraminifera. The largest one measures but 0.05 mm. without the spines.

The figure given here is from the original of Doctor Flint.

### CRITHIONINA ROTUNDATA, new species.

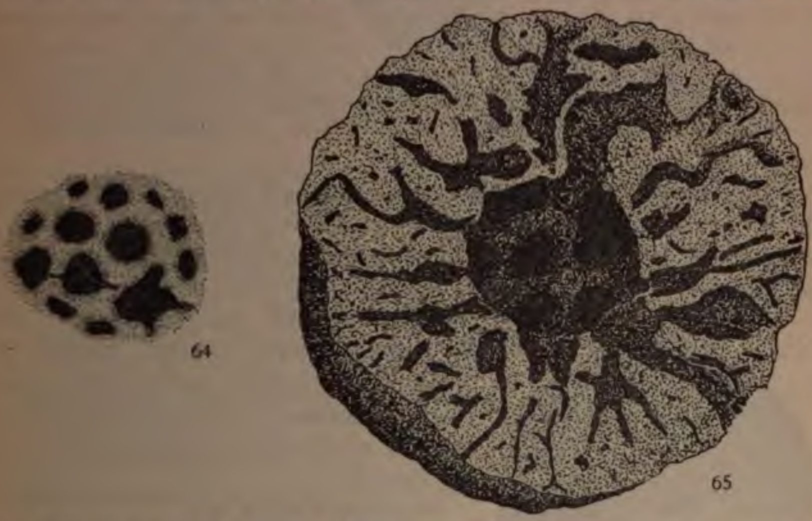
*Description.*—Test free, subspherical, composed of loosely agglutinated sand grains; surface with many pores leading by canals through the thick walls to the single central chamber, which is simple, nearly spherical, and small compared to the size of the test; wall of the chamber with many circular or roughly polygonal openings which ramify into the canals leading to the surface; wall of the central chamber and canals firmer than the rest of the test, usually showing in these firmer portions a reddish-brown cement; color dark grayish brown.

Diameter 3–6 mm.

*Distribution.*—Specimens of this species were common in the material from *Albatross* station D4327, off San Diego, Cal., 263–330 fathoms.

*Type-specimen.*—Cat. No. 8259, U.S.N.M.

This species is perhaps nearest to *Crithionina rugosa* and *C. mamilla* Goës. It is very much larger than either of those species and has a more definite structure. *C. mamilla* is an attached form of small size. *C. rugosa* is also a small, subspherical species. I have examined the original specimens of *C. rugosa* selected by Goës from the type station, and they are all small and largely made up of white, finely granular material of an entirely different appearance from this species. This is by far the largest species yet known in this genus.



FIGS. 64-65.—CRITHIONINA ROTUNDATA. 64, PORTION OF CENTRAL CHAMBER WALL. × 25. 65, VIEW OF SECTIONAL SPECIMEN SHOWING THICK WALL AND RADIAL TUBES. × 10.

## Genus THURAMMINA H. B. Brady, 1879.

*Thurammina* H. B. BRADY (type, *T. papillata* H. B. BRADY), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 45.—BÜTSCHLI, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 202.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 321.

*Thyrammina* RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 236.

*Lituola* W. B. CARPENTER (part), The Microscope, 5th ed., 1875, p. 533.

*Description.*—Test typically free, usually nearly spherical, but in some species compressed, chamber single and undivided in typical species; wall thin, composed of fine sand with more or less chitin; apertures several to many at the end of nipple-like protuberances of the surface, occasionally wanting.

Two species occur rarely in the North Pacific; the third species, described by Goës, does not seem to be a Foraminifer as far as can be made out by a study of Goës's material.

### THURAMMINA PAPILLATA H. B. Brady.

"*Orbuline Lituola*" W. B. CARPENTER, The Microscope, 5th ed., 1875, p. 533, fig. 273 *g*, *h*.

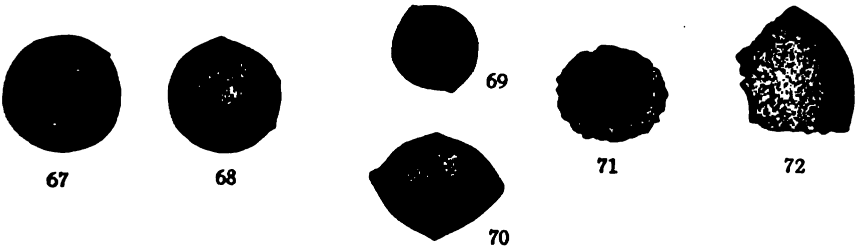
*Thurammina papillata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 45, pl. 5, figs. 4-8.—W. B. CARPENTER, The Microscope, 6th ed., 1881, p. 561, fig. 320 *g*, *h*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 321, pl. 36, figs. 7-18.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 263, pl. 5, fig. 9.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 17.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 25.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 278, pl. 22, fig. 1.

*Thyrammina papillata* RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 238, fig. 68*a-c* (in text).

*Description.*—Test usually free and rounded, occasionally adherent, the lower surface being adapted to the shape of the object to which it is adherent; usually a single chamber, but occasionally another chamber is found within the outer one; wall very thin, composed of small sand grains very neatly cemented with a reddish-brown cement, giving the whole test a reddish brown color; apertures numerous, variable, situated at the ends of nipple-like projections of varying length.

somewhat thicker than those of the type [*T. papillata*]; texture very finely arenaceous; color nearly white. Diameter about $\frac{1}{90}$th inch (0.28 mm.)."

*Distribution.*—Brady does not definitely record this species from the North Pacific in volume 9 of the *Challenger* Report, but in the second part of the volume on the "Summary of Results," this species is recorded on page 965, from station 246, 2,050 fathoms in the middle of the North Pacific.



FIGS. 67-72.—THURAMMINA ALBICANS. 67-70, SIDE VIEWS. × 50. 71, SECTION SHOWING THICKNESS OF WALL AND CHARACTER OF THE INTERIOR. × 50. 72, SECTION OF TEST SHOWING MINUTE STRUCTURE, × 100 (FIGS. AFTER BRADY).

The description and figures are from Brady.

### THURAMMINA ERINACEA Goës.

*Thurammina erinacea* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 26, pl. 2, figs. 9, 10.

*Thyrammina erinacea* RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 237, fig. 66 *a*, *b*, (in text).

I have examined the material selected by Goës as belonging to this species and am inclined to think that they are Radiolaria and not Foraminifera at all. Radiolaria of this form and size are not uncommon on both sides of the Pacific. The mounted specimens are fastened to a strip of cardboard and are not easily examined, but some of the specimens are plainly Radiolaria.

Goës recorded this species from nine *Albatross* stations along the west coast of Mexico and Central America in 557–1,879 fathoms.

## Subfamily 3. HYPERAMMININÆ.

Test consisting of a globular proloculum and a more or less elongated, sometimes branching portion, but not divided into chambers; free or attached, wall of various agglutinated materials.

In this subfamily are included a number of genera with the above characters common to all. The main distinction between such genera as *Hyperammina*, *Botellina*, *Ammolagena*, etc., seems to be in the material of the test and the habit of growth rather than in essential differences in the general form of the test. All are of agglutinated material. In *Sagenina* the test is very much branched, sometimes anastomosing, but in essential features other than its excessive branching seems to belong with the others of this family.

## Genus HYPERAMMINA H. B. Brady, 1878.

*Rhabdopleura?* DAWSON, Ann. Mag. Nat. Hist., ser. 4, vol. 7, 1871, p. 86.
*Hyperammina* H. B. BRADY (type, *H. elongata* H. B. BRADY), (part), Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 433.—BÜTSCHLI, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 193.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 257.—RHUMBLER, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 82; Arch. Protistk., vol. 3, 1903, p. 257.
*Hyperammina*+*Bactrammina* EIMER and FICKERT, Zeitschr. wiss. Zool., vol 65, 1899, pp. 673, 675.

*Description.*—Test free, elongate, in general a simple cylindrical tube with a swollen proloculum at the proximal end, the distal end open and serving as the aperture, wall composed of sand grains, interior usually smoothly finished.

There are several species of *Hyperammina* in the North Pacific, but in general they are the species that are also known from other ocean basins. In general they are found in cool water and often at considerable depths.

### HYPERAMMINA ELONGATA H. B. Brady.

*Hyperammina elongata* H. B. BRADY (part), Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 433, pl. 20, figs. 2 *a*, *b*; Quart. Journ. Micr. Sci., vol. 19, 1879, p. 72; Denkschr. kais. Akad. Wiss. Wien, vol. 42, 1881, p. 98.—BALKWILL and WRIGHT, Proc. Roy. Irish Acad., vol. 3, 1882, p. 546.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 257, pl. 23, figs. 4, 7 (not 9, 10).—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 17, pl. 4, figs. 56–58 (not 55).—

tube, little if at all constricted; color gray, sometimes brown, depending largely upon the color of the sand grains.

Diameter about 0.5 mm.; length up to 8 mm.

*Distribution.*—This species seems to be well distributed in the North Pacific. The *Challenger* records note it but twice in this region, in the abyssal region at 2,300 and 3,125 fathoms. Goës records it from two stations in the southeast portion of the region, *Albatross* stations D3375, 1,201 fathoms, and D3407, 885 fathoms.

I have records of its occurrence at about twenty *Albatross* and *Nero* stations in 110–2,848 fathoms. These stations are off California, near Hawaii, several near the Bonin Islands, five on the southeast coast of Japan, and two in Bering Sea.

Specimens of this species are usually without the proloculum, but a number of specimens in the present series show the complete test. It is of sand grains, coarse for the size of the tube as a rule, and the proximal end is broad and almost flattened in some cases. It is rather distinct from the following variety, although the two have been found in company with one another at one station.

### HYPERAMMINA ELONGATA H. B. Brady, var. LÆVIGATA J. Wright.

*Hyperammina elongata* H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884. p. 257, pl. 23, figs. 9, 10 (not 3, 7, 8).—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 17, pl. 4, fig. 55 (not 56–58).—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 270, pl. 10, fig. 2 (in part).—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 258 (in part).

*Hyperammina elongata* H. B. Brady, var. *lævigata* J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 466, pl. 20, fig. 1.

*Description.*—Variety differing from the typical in its smooth test, great excess of cement, color yellowish or reddish brown, and the proloculum ovoid, somewhat fusiform in shape, but little larger in diameter than the tube but with somewhat of a constriction where it unites with the tube; usually of smaller size than the typical form.

*Distribution.*—Apparently more rare in the North Pacific than the typical, but not so everywhere. I have found specimens of this variety from *Nero* station 12, in 1,924

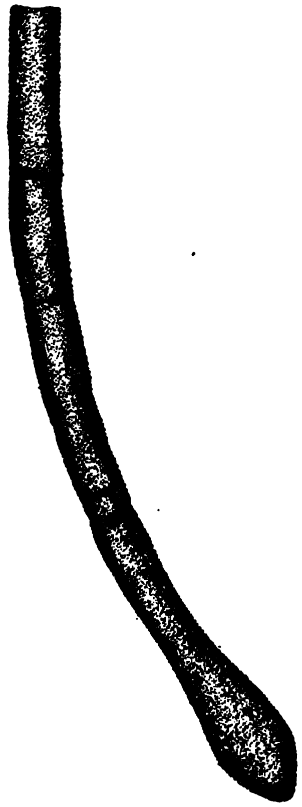
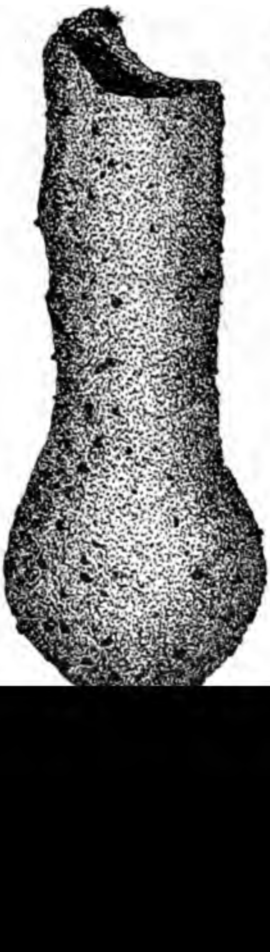


Fig. 75.—Hyperammina elongata, var. lævigata. Specimen from *Albatross* station D4979, off Japan. × 40.

fathoms, near the Hawaiian Islands, station 1012, in 1,932 fathoms, north of Guam, and at *Albatross* stations D4970 and D4979, southeast of Japan, in 500 and 743 fathoms. At the last station it occurs with the typical form.



This variety seems to be rather distinct, and should be more definitely recorded, as it has certain characters of more than varietal rank, but it is kept here for the present.

### HYPERAMMINA FRIABILIS H. B. Brady.

*Hyperammina elongata* H. B. BRADY (part), Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 433; Quart. Journ. Micr. Sci., vol. 19, 1879, p. 32.

*Hyperammina friabilis* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 258, pl. 23, figs. 1-3, 5, 6.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 17, pl. 4, fig. 59; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 22.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 269, pl. 10, fig. 1.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 258, fig. 99 *a*, *b*, in text.

*Description.*—Test elongate, subcylindrical, or tapering somewhat toward the distal end, nearly straight, test composed of coarse sand grains, wall thick and loosely cemented, exterior roughened, interior rather smooth, proximal end closed, forming a nearly spherical proloculum from which the elongated tubu-

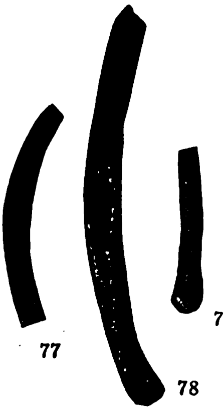
### HYPERAMMINA MAXIMA, new species.

*Description.*—Test elongate, straight or slightly curved, large, composed of a swollen proloculum and an elongate tubular chamber; wall thick, composed of sand grains and sponge spicules, rather loosely cemented, aperture rounded, formed by the open end of the tube; color gray or light brownish-gray.

Length up to 40 mm., diameter 2 mm.

*Type-specimen.*—Cat. No. 8211, U.S.N.M., from *Albatross* station D4337, off California.

This species is much larger than any of the others of the genus. Its walls have a large proportion of sponge spicules. At the type station this species occurred in great quantities with other arenaceous species.



FIGS. 77-79.—HYPERAMMINA MAXIMA. × 2. FROM PHOTOGRAPH.

### HYPERAMMINA SUBNODOSA H. B. Brady.

*Rhabdopleura*, species, G. M. DAWSON, Ann. Mag. Nat. Hist., ser. 4, vol. 7, 1871, p. 86, fig. 7.

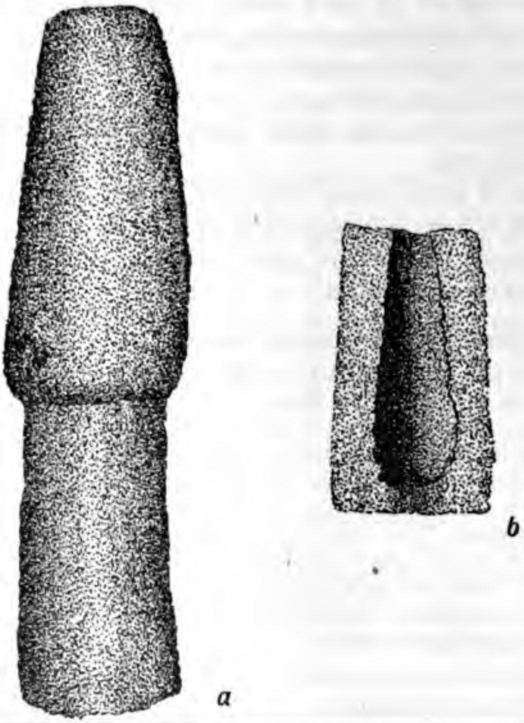
*Hyperammina subnodosa*, H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 259, pl. 23, figs. 11-14.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 255, pl. 4, fig. 32.—GOËS, Kongl. Svensk. Vet. Akad. Handl, vol. 25, No. 9, 1894, p. 16, pl. 3, figs. 42-53 (not 54).—SCHLUMBERGER, Mém. Soc. Zool. France, vol. 7, 1894, p. 254.—RHUMBLER, Arch. Protistk, vol. 3, 1903, p. 259, fig. 100 *a*, *b* (in text).

*Description.*—Test elongate, subcylindrical, comparatively large, proximal end enlarged into a thick-walled proloculum, tube constricted at intervals and with much thicker walls, coarsely arenaceous, aperture at the distal end of the tube, circular; color grayish.

Length up to 18 mm.

*Distribution.*—This species seems to be rare in the North Pacific. There are five records of its occurrence: *Challenger* stations 237, 241 east of Japan, in 1,875 and 2,300 fathoms; one station in the Okhotsk Sea, recorded by Schlumberger, in 280 meters; one *Albatross* station D5026, also in the Okhotsk Sea but a short distance from the preceding, 119 fathoms; and *Nero* station 1164, near the Bonin Islands, in 2,384 fathoms.

It may be worthy of note that at the shallowest station, *Albatross* station D5026, the bottom temperature in September was 30.4° F., even colder than at the abyssal stations where the species was found.



### SACCORHIZA RAMOSA (H. B. Brady).

*Hyperammina ramosa* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 33, pl. 3, figs. 14, 15; Denkschr. kais. Akad. Wiss. Wien, vol. 42, 1881, p. 98; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 261, pl. 23, figs. 15-19.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, no. 7, 1888, p. 217, pl. 41, figs. 1-4, 13.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 255, pl. 4, fig. 15.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 18, pl. 4, figs. 61, 62.—Chapman, Proc. Zool. Soc. London, 1895, p. 13.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 22.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 270, pl. 11, fig. 1.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 260, figs. 101 *a*, *b* (in text).

*Saccorhiza ramosa* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 670.

*Description.*—Test free, proloculum ovoid passing into the branched tubular portion, branching irregular, wall fairly thick, composed of sand, more or less coated with sponge spicules exteriorly, rough; apertures at the ends of the tubes, color grayish.

*Distribution.*—This species seems to be generally distributed in the whole North Pacific, twenty-five or more well scattered stations having been noted. However, none of these records are north of latitude 40° N., but this is probably due to the fact that little material has been available in deep water north of that line.

Complete specimens are very rare, but the fragmentary specimens, which are readily recognized, are common. This species is very different from the typical *Hyperammina* with the single tube and the ordinary sand grains. The investment of sponge spicules shows a selective character rather marked, for they are present on the test even from deep red-clay areas where spicules are not frequent in the same bottom sample in which the tests occur.

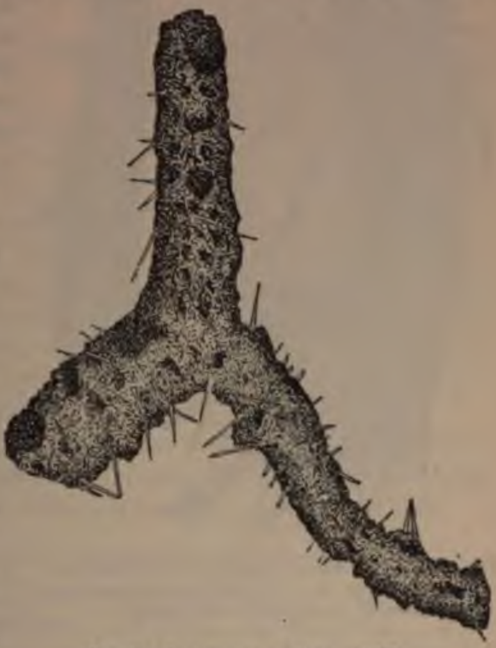


Fig. 81.—Saccorhiza ramosa. × 100.

The figured specimen had very few spicules compared with the majority of specimens.

Specimens were obtained in the cold water off Japan in 39 fathoms, *Albatross* station D4946. The greater number of stations are over 1,000 fathoms, however, the deepest record of its occurrence being 3,125 fathoms.

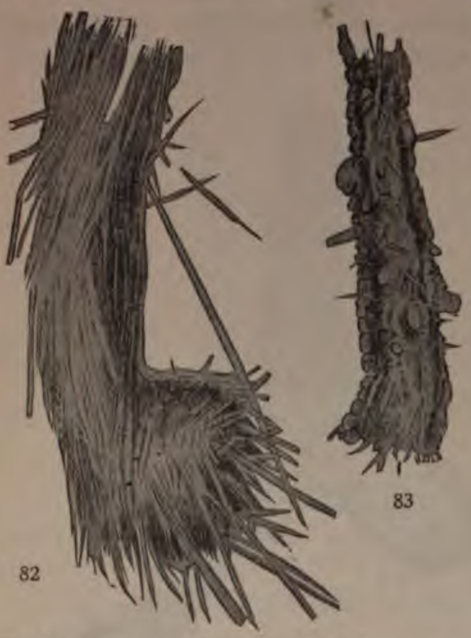
### SACCORHIZA CALCILEGA (Rhumbler).

*Hyperammina calcilega* Rhumbler, Zool. Jahrb. Abth. Syst., vol. 24, 1906, p. 24, pl. 2, figs. 1, 2.

*Description.*—Test free, consisting of a nearly spherical proloculum and a tubular portion, wall composed of calcareous sponge spicules and of other foreign calcareous granules; color white.

Length 0.6–0.9 mm., breadth 0.15–0.24 mm.

*Distribution.*—Two specimens from which Rhumbler described this species were found in shallow water at Laysan. Both are fragmentary specimens of small size, but their characters, especially the sponge spicules, would place the species in the genus *Saccorhiza*, as here considered. The calcareous nature of the foreign matter of the wall is not surprising when the almost universal calcareous nature of coral reef material is considered.



Figs. 82–83.—Saccorhiza calcilega. 82, specimen showing proloculum. × 115. 83, specimen showing apertural portion. × 60 (after Rhumbler).

## Genus TOLYPAMMINA Rhumbler, 1895.

*Hyperammina* H. B. Brady (part), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 33; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 260.

*Tolypammina* Rhumbler (type, *Hyperammina vagans* H. B. Brady), Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 83; Arch. Protistk., vol 3, 1903, p. 276.

*Serpulella* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 674.

*Description.*—Test typically adherent by its under surface, but may become free, consisting of an elongated oval proloculum and long irregular tube, unbranched, composed of sand grains and reddish-brown cement.

Rhumbler has proposed the above genus for the *Hyperammina vagans* of Brady. The attached habit and character of building the test seem sufficient grounds for its separation from others of the species usually assigned to *Hyperammina*. Eimer and Fickert also proposed a generic name for this species, but the name proposed by Rhumbler is several years earlier and is here used.

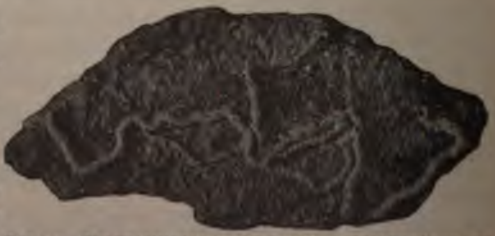


Fig. 84.—Tolypammina vagans. × 10. From photograph.

### TOLYPAMMINA VAGANS (H. B. Brady).

*Hyperammina vagans* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 33, pl. 3, fig. 5; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 260, pl. 24, figs. 1-9.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 270, pl. 11, fig. 2.

*Tolypammina vagans* RHUMBLER, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 83; Zeitschr. allg. Phys., vol. 2, 1902, p. 281, fig. 97; Arch. Protistk., vol. 3, 1903, p. 277, fig. 125 *a*, *b* (in text).

*Serpulella vagans* EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 674.

*Description.*—Test typically adherent, consisting of an oval-elongate proloculum and a long irregularly winding tube of rather uniform diameter, unbranched, wall composed of sand grains of small size and united by a reddish-brown cement often in considerable amount, surface rather smooth, color reddish-brown, the proloculum often darker than the tubular portion.

Diameter 0.05–0.2 mm., length 1 mm. or more.

*Distribution.*—This species occurred at four *Challenger* stations and at eight stations in the *Albatross* and *Nero* material. These are well scattered in the region west of longitude 150° W. and south of latitude 40° N. Most of the stations are over 1,500 fathoms, but it has been noted in shallower water off Japan, *Albatross* stations D4949, in 110 fathoms, D4957 in 437 fathoms. It occurred near the Hawaiian Islands, H2922 in 268 fathoms. The deepest record for this species in the North Pacific is at *Albatross* station H4014, 3,800 fathoms, attached to *Hyperammina friabilis*.

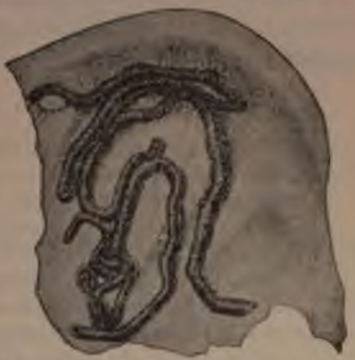


FIG. 85.—TOLYPAMMINA VAGANS. × 15 (AFTER BRADY). PROLOCULUM OF SPECIMEN SHOWN IN FIGURE JUST ABOVE THE MIDDLE.

### Genus AMMOLAGENA Eimer and Fickert, 1899.

*Trochammina* JONES and PARKER (part), Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.—W. B. CARPENTER, PARKER, and JONES, Intr. Study Foram., 1862, p. 142.

*Webbina* H. B. BRADY (part), Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 711 (not *Webbina* D'ORBIGNY, 1839); Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 349.

*Ammolagena* EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 673 (type, *Trorhammina irregularis*, var. *clavata* PARKER and JONES).

*Webbinella* RHUMBLER (part), Arch. Protistk., vol. 3, 1903, p. 229.

*Description.*—Test adherent, composed of an oval proloculum with a tubular chamber of variable length but of nearly uniform diameter, the open end serving as the aperture; wall finely arenaceous but with an excess of cement, proloculum without a definite floor.

The generic name of this species following should be that proposed by Eimer and Fickert. *Webbina* as used by Brady is not at all the use as proposed by d'Orbigny. Eimer and Fickert proposed the name *Ammolagena* in 1899. Rhumbler includes with this species *Webbinella hemisphærica*, but as *Ammolagena* had already been proposed for it the name of *Ammolagena* Eimer and Fickert should stand and thus the generic name *Webbinella* is left for *Webbinella hemisphærica* in a restricted sense. The two species seem to be very distinct, *Ammolagena clavata* having a proloculum and long tubular chamber with the aperture at the end of the tube. *Webbinella hemisphærica* consists simply of a single adherent chamber with the aperture at the rim of attachment, and there is nothing corresponding to the long tubular portion seen in *Ammolagena clavata*.

The two species seem to be generically distinct and one seems related to the *Hyperammina* group and the other, *Webbinella*, to the single-chambered Saccammininæ.

### AMMOLAGENA CLAVATA (Parker and Jones).

*Trochammina irregularis*, var. *clavata* PARKER and JONES, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.

*Trochammina irregularis* (part), W. B. CARPENTER, PARKER, and JONES, Intr. Study Foram., 1862, p. 142, pl. 11, fig. 6.

*Webbina clavata* H. B. BRADY, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 711; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 349, pl. 41, figs. 12–16.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, pt. 7, 1888, p. 218, pl. 42, fig. 21.—J. WRIGHT, Proc. Roy. Irish Acad., vol. 1, 1891, p. 470, pl. 20, figs. 2, 3.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 32, pl. 6, figs. 245, 246.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 18.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 35.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 279, pl. 24, fig. 3.—KIÆR, Norske Nordhavs-Exp. no. 25, 1899, p. 4.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 129.

Longer diameter of the proloculum 0.5–1 mm.

*Distribution.*—The only *Challenger* record for this species is found in the volume on "Summary of Results." It is there recorded from station 237, 1,875 fathoms, east of Japan. Brady, in the ninth volume of "the *Challenger* Report," writes that it is a curious fact that he had not met with a single specimen in any of the North Pacific dredgings. In the Eastern North Pacific Goës has recorded this species from three stations off the coast of Mexico and Central America, 660–1,201 fathoms. Bagg records it from six stations in the vicinity of the Hawaiian Islands, 104–978 fathoms. In the present work I have found it from *Albatross* station D3431 where Goës records it, H2999, 549 fathoms, and *Nero* station 2032, 1,014 fathoms, both in the vicinity of the Hawaiian Islands.

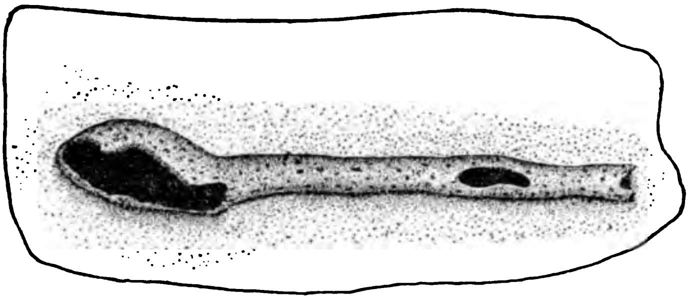


Fig. 88.—Ammolagena clavata. × 50. Specimen attached, portion of proloculum broken away. Microspheric specimen with small proloculum and comparatively long tubular portion.

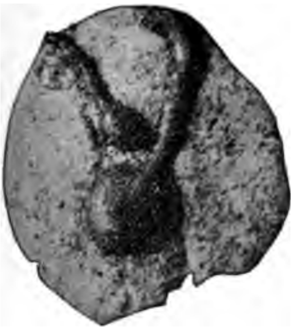


Fig. 89.—Ammolagena clavata. × 15. (From photograph). Microspheric and megalospheric specimens attached side by side.

I have examined Goës's selected material and also that selected by Bagg, now in the National Museum.

Besides being attached to pebbles, sand, grains, shells, etc., I have noted its occurrence on the following genera of Foraminifera: *Ammodiscus*, *Cyclammina*, *Rhabdammina*, *Haplophragmium*, *Biloculina*, *Pulvinulina*, and *Cristellaria*.

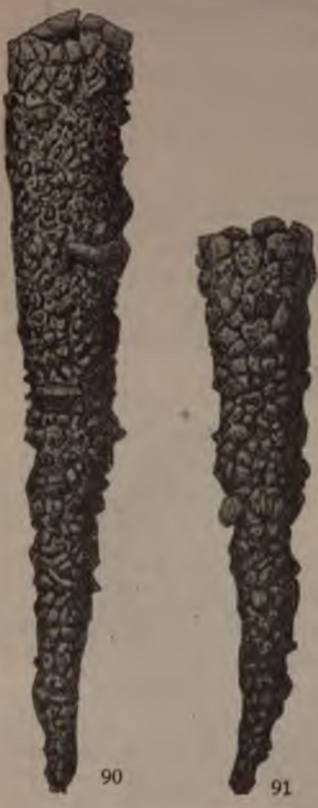
Wright, 1891, speaks of the difference in the length of tube being related to the size of the proloculum, the shorter tube with the larger proloculum, and the reverse. This would indicate a true dimorphism and would correspond to what is known in other groups, that the largest test is usually that with a microspheric proloculum.

### Genus JACULELLA H. B. Brady, 1879.

*Jaculella* H. B. BRADY (type, *J. acuta* H. B. BRADY), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 35.—BÜTSCHLI, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 193.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 255.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 273.

*Description.*—Test free, elongate, conical, widest at the apertural end, opposite end closed; wall thick, composed of sand grains roughly cemented on the exterior.

In *Jaculella* the distinction between proloculum and tubular chamber is not as marked as in some of the other genera, but in *J. obtusa* the relation is often made out more definitely. There are but two described species, both of which are recorded from the North Pacific, though but rarely.



FIGS. 90-91.—JACULELLA ACUTA. × 12 (AFTER BRADY).

### JACULELLA ACUTA H. B. Brady.

*Jaculella acuta* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 35, pl. 3, figs. 12, 13.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 19, no. 4, 1882, p. 143, pl. 12, fig. 432.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 255, pl. 22, figs. 14-18.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 23.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 269, pl. 9, fig. 4.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 273, fig. 122 (in text).

*Description.*—Test elongate, straight, tubular, proximal end closed and acutely pointed, distal end broader, slightly constricted to form the aperture which is circular, wall thick, composed of coarse sand grains, firmly cemented, exterior rough, proximal end of the test often reddish-brown, distal portion grayish.

Length variable, up to 25 mm. or even more.

*Distribution.*—Brady records this species at but one North Pacific *Challenger* station, 244, in 2,900 fathoms, in mid-Pacific. I have seen two specimen from *Albatross* station H2684 in 1,12 fathoms and H2917 in 2,615 fathoms, one off the coast of California, the other near the Hawaiian Islands.

The closed end of the specimens seems to be easily detached a they are rarely found complete.

### JACULELLA OBTUSA H. B. Brady.

*Jaculella obtusa* H. B. Brady, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 714; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 256, pl. 22, figs. 19–22.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 20, pl. 4, figs. 87–89; pl. 5, figs. 90, 91; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 23.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 273, fig. 123 (in text).

*Description.*—Test elongate, straight, tubular, proximal end closed, obtusely rounded, distal end but slightly broader, its open end forming the aperture, wall thick, composed of sand grains, firmly cemented, rough, grayish in color.

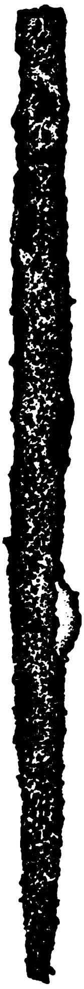


Fig. 92.—Jaculella obtusa. × 15.

Length 10–15 mm.

*Distribution.*—Known from a single *Challenger* station, No. 237, in 1,875 fathoms, east of Japan. Goës found specimens from *Albatross* station D3407, 885 fathoms, off the west coast of Mexico. I have found numerous other specimens from this latter station and have a few specimens from Bering Sea, *Albatross* station D3501, in 688 fathoms.

This species is often nearly cylindrical or wider in the middle than at either end, the texture rather less firm than is that of *J. acuta.*

## Genus SAGENINA Chapman, 1900.

*Sagenella* H. B. Brady (type, *S. frondescens* H. B. Brady), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 41; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 278 (not *Sagenella* Hall).

*Sagenina* Chapman, Journ. Linn. Soc., vol. 28, 1900.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 221.

*Description.*—Test attached, tubular, dichotomously or irregularly branching, often anastomosing; wall arenaceous; apertures at the ends of the branches.

This genus contains several species, all occurring as far as known in the eastern seas and in tropical waters or in some cases subtropical as well.

### SAGENINA FRONDESCENS (H. B. Brady).

*Sagenella frondescens* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 41, pl. 5, fig. 1.—Bütschli, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 195, pl. 5, fig. 16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 278, pl. 28, figs. 14, 15.

*Sagenina frondescens* Chapman, Journ. Linn. Soc., vol. 28, 1900, p. 4, pl. 1, fig. 1.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 221, fig. 46 (in text).

*Description.*—Test attached, tubular, stout, the tubes forming an irregular network over the surface to which they are attached, dichotomously branching or irregular and often anastomosing to form a reticulated network; wall of fine sand with a small proportion of cement, rather thin; apertures at the ends of the tubes, rounded; color white, gray, or brown.

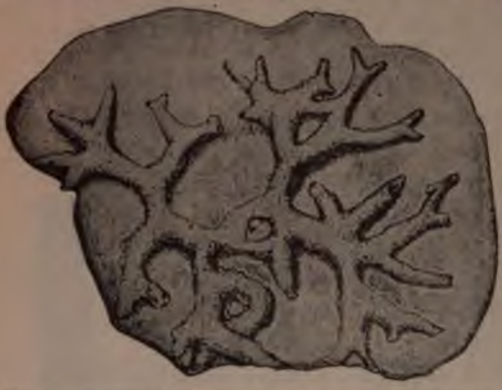


FIG. 93.—SAGENINA FRONDESCENS. × 10 (AFTER BRADY).

Diameter of the main tubes up to 0.5 mm., of the smaller ones as small as 0.12 mm.

*Distribution.*—Brady described this species from shallow water about the Admiralty and Friendly islands. A single fragmentary specimen was obtained from *Albatross* station D 4922 in Vincennes Strait, south of Japan, in 60 fathoms. At this and adjacent stations many other species of tropical Foraminifera seem to reach their northern limit.

**SAGENINA RAMULOSA, new species.**

*Description.*—Test attached, tubular, branching profusely at a small angle, tubes often massed or confluent; wall composed of fine coralline mud, smooth; apertures at the ends of the tubes; color, white.

Diameter of the tubes, 0.1–0.2 mm.

*Type-specimen.*—Cat. No. 8232, U.S.N.M., from *Nero* station 1066, off Guam, 234 fathoms in coral mud, attached to fragments of worn shell.

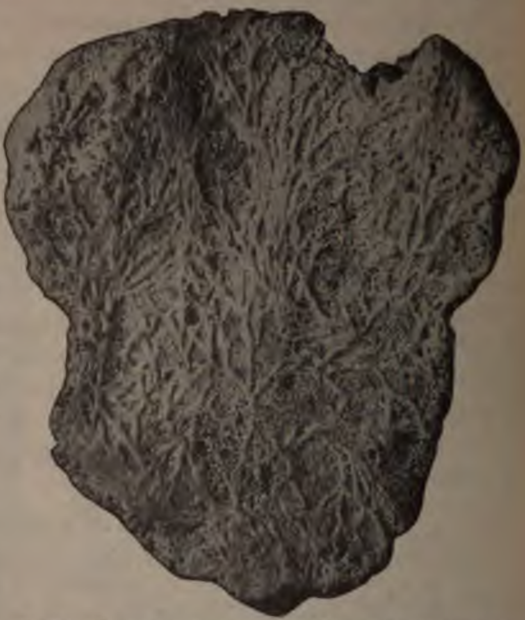


FIG. 94.—SAGENINA RAMULOSA. × 15. FROM PHOTOGRAPH.

This species is very slender, much more profusely branching than any specimens of the preceding species that I have seen, and most of the branching at a very acute angle.

### Subfamily 4. AMMODISCINÆ.

Test composed of a globular proloculum and long undivided tube, closely coiled, either planospirally or in changing planes or to form a spiral test; wall of fine sand with much cement.

*Ammodiscus* and its allies *Gordiammina*, *Ammodiscoides*, and *Turritellella* form a rather unified group in that they are all close coiled and are of fine material, with an abundance of reddish cement. As far as known the tests are all free. In *Ammodiscus* the two forms, microspheric and megalospheric, are known to occur.

### Genus AMMODISCUS Reuss, 1861.

*Operculina* (part) D'ORBIGNY, Foram. Cuba, 1839, p. 71.

*Orbis* STRICKLAND, Quart. Journ. Geol. Soc., vol. 2, 1846, p. 30 (not *Orbis* of PHILIPPI, 1844=*Cornuspira*).

*Spirillina* WILLIAMSON, Recent Foraminifera of Great Britain, 1858, p. 93 (not *Spirillina* EHRENBERG, 1841).

*Trochammina* (part) JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.—W. B. CARPENTER, PARKER, and JONES, Intr. Study Foram., 1862, p. 141.

*Ammodiscus* (part) REUSS, Sitz. kais. Akad. Wiss. Wien, vol. 44 (1), 1861 (1862), p. 365.—BÜTSCHLI, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 189.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 329.—RHUMBLER, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 84.—EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 614.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 280. (Type, *A. incertus* D'ORBIGNY =*Operculina incerta* D'ORBIGNY).

*Cornuspira* (part) REUSS, and various authors (not *Cornuspira* SCHULTZE, 1854).

*Involutina* (part) TERQUEM, Mém. Acad. Imp. Metz, 1860–61 (1862), p. 450; 1862–63 (1863), p. 221.

*Description.*—Test free, spiral, composed of a proloculum and long undivided tubular second chamber, coiled regularly in one plane, wall finely arenaceous, cement usually brown, surface smooth.

I have restricted *Ammodiscus* to the basis of Rhumbler, including only those species which have a truly planospiral test.

#### AMMODISCUS INCERTUS (d'Orbigny).

*Operculina incerta* D'ORBIGNY, in De la Sagra, Hist. Phis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 49, pl. 6, figs. 16, 17; Spanish Edit., 1840, p. 71, pl. 6, figs. 16, 17.

*Spirillina arenacea* WILLIAMSON, Recent Foraminifera of Great Britain, 1858, p. 93, pl. 7, fig. 203.

*Trochammina squamata*, var. *incerta* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.—PARKER and JONES, Appendix to W. B. CARPENTER, PARKER, and JONES, Intr. Study Foram., 1862, p. 312.

*Trochammina incerta* W. B. CARPENTER, PARKER, and JONES, Intr. Study Foram., 1862, p. 141, pl. 11, fig. 2.—HAEUSLER, Ann. Mag. Nat. Hist., ser. 5, vol. 10, 1882, p. 52, pl. 3.

*Ammodiscus incertus* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 330, pl. 38, figs. 1-3.—SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1889, p. 484, pl. 11, fig. 7.—BURROWS, SHERBORN, and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 552, pl. 8, fig. 8.—J. WRIGHT, Proc. Roy. Irish Acad., vol. 1, 1891, p. 468.—Chapman, Journ. Roy. Micr. Soc., 1892, p. 326, pl. 6, fig. 11.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 263, pl. 5, figs. 35, 36.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 31, pl. 6, figs. 238, 239.—Chapman, Proc. Zool. Soc. London, 1895, p. 17.—Ann. Mag. Nat. Hist., ser. 6, vol. 16, 1895, p. 315, pl. 11, figs. 8, 9.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 34.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 278, pl. 23, fig. 2.—Millett, Journ. Roy. Micr. Soc., 1899, p. 362.—Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 614, fig. 32 (in text).—Rhumbler, Zeitschr. allg. Phys., vol. 2, 1902, p. 1, fig. 18; Arch. Protistk., vol. 3, 1903, p. 280, fig. 129 (in text).—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 5.

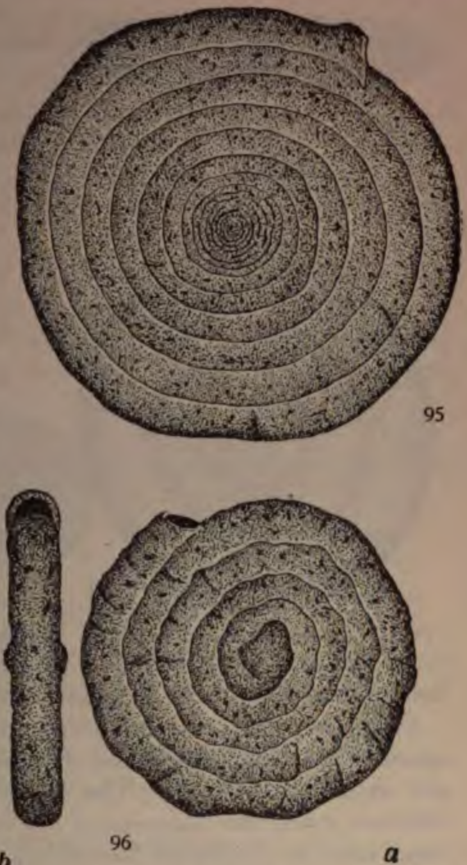
*Ammodiscus tenuis* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 51; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 332, pl. 38, figs. 4–6.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 31, pl. 6, figs. 240, 241.—Chapman, Proc. Zool. Soc. London, 1895, p. 18.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 279, pl. 23, fig. 1.—Rhumbler, Arch. Protistk., vol. 3, 1903, p. 281, fig. 130 (in text).

*Description.*—Test composed of an ovoid proloculum and long spirally coiled, undivided second chamber, coils in a single plane, gradually increasing in size, in the microspheric form very small in the center, in the megalospheric form much larger in the central portion and increasing but little in succeeding coils, in the adult condition chamber about as wide as high, building no floor of its own, aperture at the open end of the chamber, wall arenaceous, usually with an excess of cement, color usually a reddish or reddish-brown, in alcoholic specimens and sometimes in dry ones with the portion about the aperture white.

Diameter of test up to 6 mm.

*Distribution.*—Brady records a single station for this species in

e seems to be no great doubt that *Ammodiscus tenuis* H. B.
is the megalospheric form of the species of which *A. incertus*
igny) is the micro-
form. From one sta-
*lbatross* D3431, there
29 specimens, 26 of
were microspheric (*A.*
*s*) and 103 megalo-
(*A. tenuis*); at station
, of 16 specimens, 2
nicrospheric. At sta-
)4337, 19 out of 30
ens were microspheric.
eral other stations both
were obtained, but the
t of material did not
of a large series being
d. In general, the meg-
eric form is the more
n, the usual feature
er series of the two
have been studied in
enera. Also the micro-
form is usually much
han the megalospheric
he entire growth is fin-
This also seems to be
neral rule in the other
inifera observed from
andpoint.



FIGS. 95-96.—AMMODISCUS INCERTUS. × 20. 95, LARGE FORM WITH MICROSPHERIC PROLOCULUM AND MANY SMALL EARLY COILS. 96 *a*, FORM WITH MEGALOSPHERIC PROLOCULUM, MADE UP OF A FEW LARGE COILS, THE A. TENUIS H. B. BRADY WHICH IS THE MEGALOSPHERIC FORM OF A. INCERTUS (D'ORBIGNY); *b*, APERTURAL VIEW OF SAME SPECIMEN SHOWING THE MEGALOSPHERIC PROLOCULUM OF GREATER DIAMETER THAN THE SUCCEEDING PORTIONS OF THE TEST.

### MODISCUS EXSERTUS,
new species.

*ription.*—Test consist-
a proloculum and long
ded tubular chamber
coiled for several rev-
s, then uncoiling, but in the same plane, by a straight tube,
ely arenaceous, with a reddish-brown cement, aperture at the
the uncoiled portion, a circular opening slightly constricted.
neter 0.45 mm.

*Type-specimen.*—Cat. No. 8260, U.S.N.M., from *Albatross* D4979, in 943 fathoms, off the south coast of Honshu Island, Japan.

The specimen figured by Brady[a] has a similar form, but less developed.

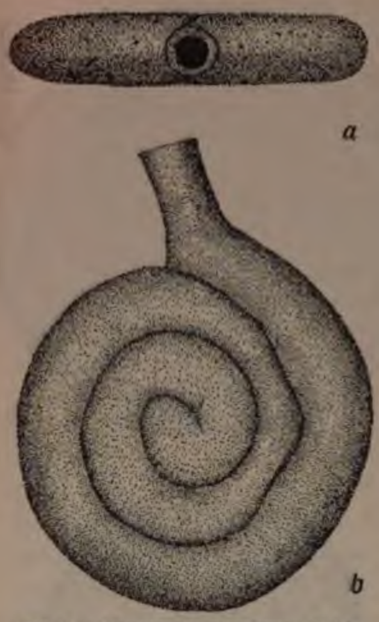


FIG. 97.—AMMODISCUS EXSERTUS. × 100. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

## Genus GORDIAMMINA Rhumbler, 1895.

*Trochammina* (part) JONES and PARKER, Quart. Journ. Geol. Soc., vol. 61, 1860, p. 304.

*Ammodiscus* (part) SIDDALL and H. B. BRADY, Cat. Brit. Rec. Foram., 1879, p. 5; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 333.

*Gordiammina* RHUMBLER, Nachr. kön. Ges. wiss. Göttingen, 1895, p. 84; Arch. Protistk., vol. 3, 1903, p. 281. Type, *G. charoides* (JONES and PARKER) = *Trochammina charoides* JONES and PARKER.

*Description.*—Test composed of a proloculum and long, undivided second chamber, winding upon itself in various planes, not completely spiral throughout, wall finely arenaceous, with much cement, smooth both without and within, color reddish or yellowish brown.

Rhumbler has proposed a new generic name to include the two species which have the coiled chamber winding in varying planes but not in a regular spire. The method of growth is certainly very different from the planospiral one of *Ammodiscus*, and the generic name used by Rhumbler has been adopted here.

### GORDIAMMINA GORDIALIS (Jones and Parker).

*Trochammina squamata*, var. *gordialis* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.—PARKER and JONES, Trans. Roy. Soc. London, vol. 155, 1865, p. 408, pl. 15, fig. 32.

*Trochammina gordialis* W. B. CARPENTER, PARKER, and JONES, Intr. Study Foram., 1862, p. 141, pl. 11, fig. 4.—JONES, PARKER, and KIRKBY, Ann. Mag. Nat. Hist., ser. 4, vol. 4, 1869, p. 390, pl. 13, figs 7, 8.—WRIGHT, Proc. Belfast Field Club, 1876–77 (App.), pl. 4, fig. 3.—HAEUSLER, Ann. Mag. Nat Hist., ser. 5, vol. 10, 1882, p. 55, pls. 3 and 4, figs. 8–20.

*Trochammina* (*Ammodiscus*) *gordialis* HAEUSLER, Neues Jahrb., 1883, p. 59, pl. 4, figs. 2, 3.

*Ammodiscus gordialis* SIDDALL and H. B. BRADY, Cat. Brit. Rec. Foram., 1879, p. 5.—BÜTSCHLI, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 196, pl. 5, fig. 22.—H. B. BRADY, Denkschr. kais. Akad. Wiss. Wien, vol. 42, 1881, p. 100; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 333, pl. 38, figs. 7–9.—HAEUSLER, Neues Jahrb., Beil., vol. 4, 1885, p. 24, pl. 3, figs.

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[a] Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 38, fig. 4.

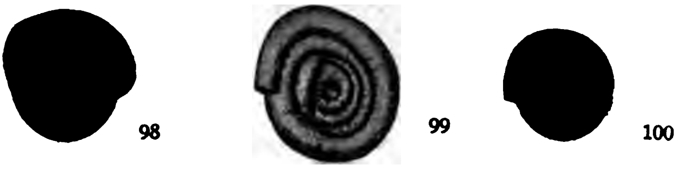
10-22, 31.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 218, pl. 42, fig. 22.—J. WRIGHT, Proc. Roy. Irish Acad., vol. 1, 1891, p. 469.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 264, pl. 5, figs. 39, 40.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 279, pl. 24., fig. 1.

*Gordiammina gordialis* RHUMBLER, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 84; Arch. Protistk., vol. 3, 1903, p. 282, fig. 132 (in text).

*Description.*—Test composed of a proloculum and long, undivided second chamber, at first planospiral like *Ammodiscus*, but soon leaving the one plane and becoming irregularly; coiled wall finely arenaceous with much cement; color reddish or yellowish brown.

Diameter 0.25–0.84 mm.

*Distribution.*—There are seven *Challenger* records for this species in the North Pacific, six of them in the abyssal region from Japan westward to the mid-Pacific and thence southward to the equator, the other one between Hongkong and Manila. These stations range a depth from 1,875 to 3,125 fathoms, mostly in red clay areas. The nly other North Pacific record is that of Flint, *Albatross* station 3080, in 93 fathoms off the coast of Oregon.



FIGS. 98-100.—GORDIAMMINA GORDIALIS. × 70 (AFTER BRADY).

Many of the figured fossil specimens are very peculiar, and a queson may be raised as to whether they all belong to this species.

### GORDIAMMINA CHAROIDES (Jones and Parker).

*Trochammina squamata*, var. *charoides* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.

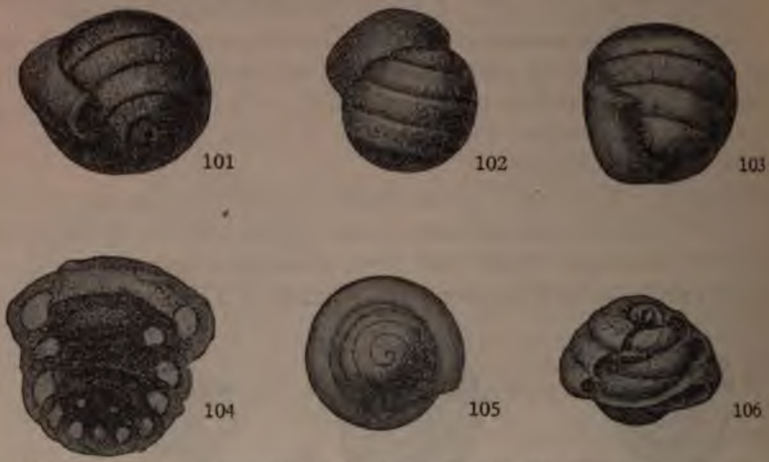
*Trochammina charoides* W. B. CARPENTER, JONES, and PARKER, Intr. Study Foram., 1862, p. 141, pl. 11, fig. 3.—SIDDALL, Proc. Chester Soc. Nat. Sci., pt. 2, 1878, p. 5.—HAEUSLER, Ann. Mag. Nat. Hist., ser. 5, vol. 10, 1882, p. 56, pl. 4, fig. 21.

*Ammodiscus charoides* BERTHELIN, Foram. de Bourgneuf et Pornichet, 1878, p. 23, no. 18.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 334, pl. 38, figs. 10-16.—J. WRIGHT, Proc. Roy. Irish Acad., vol. 1, 1891, p. 469.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 18.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 279, pl. 24, fig. 2.

*Gordiammina charoides* RHUMBLER, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 84.—KLÆR, Norske Nordhavs-Exp., no. 25, 1899, p. 4.—RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 282, fig. 133 (in text).

*Description.*—Test consisting of a proloculum and long, undivided second chamber evenly coiled in a series of layers making a subglobuar mass, then turning at right angles to its preceding axis and making finally a partial or complete revolution about the earlier-formed globular test; wall finely arenaceous with much cement; surface smooth and polished; color reddish brown.

Diameter 0.34–0.4 mm.



FIGS. 101–106.—GORDIAMMINA CHAROIDES. × 70 (AFTER BRADY). 104, SECTION THROUGH TEST. 105, APERTURAL VIEW. 106, BROKEN SPECIMEN SHOWING COILS OF INTERIOR.

*Distribution.*—This species is known in the North Pacific from two *Challenger* stations in 1,875–2,575 fathoms, east from Japan. Brady also mentions a North Pacific station "from 50–150 fathoms." Flint records the species from off the coast of Oregon, 93 fathoms, from *Albatross* station D3080.

### Genus TURRITELLELLA Rhumbler, 1903.

*Trochammina* (part) SIDDALL, Proc. Chester Soc. Nat. Sci., pt. 2, 1878, p. 46.

*Ammodiscus* (part) SIDDALL and H. B. BRADY, Cat. Brit. Rec. Foram., 1879, p. 5.—BALKWILL and MILLETT, Journ. Micr. and Nat. Sci., vol. 3, 1884, p. 25.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 335.

*Turritellopsis* RHUMBLER (not of G. O. SARS, 1878), Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 84.

*Turritellella* RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 283.

*Description.*—Test free, consisting of a proloculum and long, undivided second chamber, coiled in an elongated close spiral, wall composed of sand grains and much cement, smooth; aperture, the open end of the tubular chamber.

The single species here included has a long, closely spiral test very different from any of the preceding, and it seems proper that it should have a different generic name.

interior and having several apertures. Such forms occur most commonly among the fossil series, but are also known as recent species in the East Indies. Therefore the genus *Haplophragmium* is here restricted to those species none of which have been recorded from the North Pacific.

The planospiral forms are here separated from the trochoid ones, as in the Mollusca, for example, these two types are always distinct, and it has seemed best to keep them so even in the Foraminifera. The uncoiling and closely coiled planospiral forms have also been separated. A number of previously proposed names have been used. Certain of the genera include species not hitherto described in this group, and which are apparently new.

After a careful review of the work done by various authors the scheme of distributing the genera of the Lituolidæ among the various families with which they are supposed to have affinities, has been avoided. It is less confusing, it seems to me, to keep the family as it now is, especially when the relationships of the arenaceous and calcareous forms are so hazy and uncertain and in other cases when details of structure are carefully considered the apparent likeness is lost. It has seemed best, therefore, to regard the similarity of form as cases of parallelism and not true relationships.

### Subfamily 1. ASCHEMONELLINÆ.

Test composed of agglutinated material, divided irregularly into chambers without definite plan of arrangement.

The two species of *Aschemonella* recorded from this area are primitive in character. The chamber seems to produce orifices at irregular

### ASCHEMONELLA RAMULIFORMIS H. B. Brady.

*Aschemonella ramuliformis* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 273, pl. 27, figs. 12–15.

*Description.*—"Test free, elongate; forming an irregular, more or less branched, sometimes segmented tube, with numerous apertures, lateral and terminal. Walls very thin, but hard and firmly cemented; exterior only slightly rugose, interior surface smooth. Length, $\frac{1}{3}$ inch (8 mm.)."

*Distribution.*—Found at three *Challenger* stations in the North Pacific, 244, 246, and 253, in 2,050–3,125 fathoms. Most common at station 244 in 2,900 fathoms.

### ASCHEMONELLA CATENATA (Norman.)

*Astrorhiza catenata* NORMAN, Proc. Roy. Soc. London, vol. 25, 1876, p. 213.

*Aschemonella catenata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 42, pl. 4, figs. 12, 13; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 271, pl. 27, figs. 1–11; pl. 27 A, figs. 1–3.

*Aschemonella scabra* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 44, pl. 3, figs. 6, 7.

*Description.*—"Test free, irregularly branched; chambers numerous, inflated, variable in size and contour, usually with several tubulated orifices, each of which may produce a fresh segment. Walls thin, compactly built, exterior more or less rough, often acerose with partially embedded sponge-spicules; interior smooth. Complete specimens sometimes $\frac{5}{12}$ inch (10.5 mm.) in length."

*Distribution.*—This species is recorded at four *Challenger* stations in the North Pacific, 224, 237, 244, 246, in 1,850–2,900 fathoms. Brady speaks of the specimens from station 244 as the finest obtained by the *Challenger*.

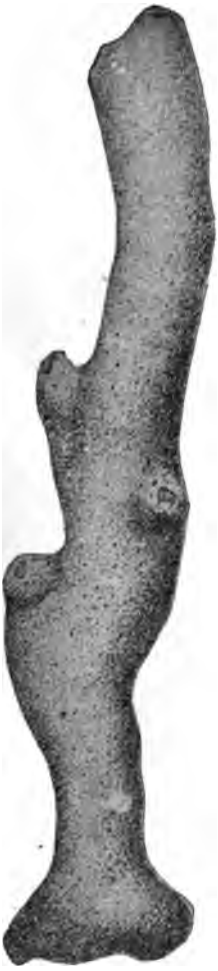
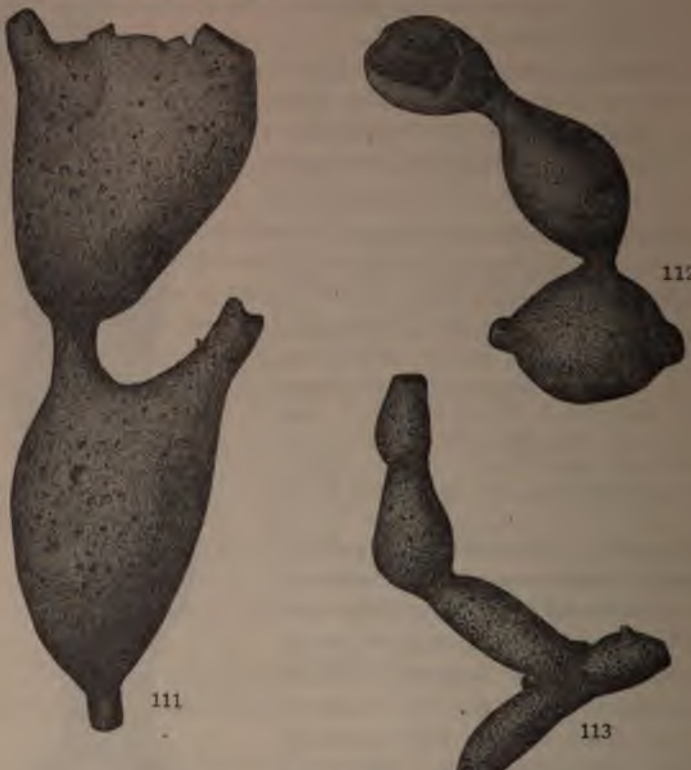


FIG. 110.—ASCHEMONELLA RAMULIFORMIS. × 15. (AFTER BRADY.)

## Subfamily 2. REOPHACINÆ.

Test of agglutinated material, sand grains, sponge-spicules, etc., with a varying amount of cement, chambers in a linear series, aperture single at the end of the last formed chamber.

This subfamily includes many species mainly belonging to *Reophax* and *Hormosina*. The chambers vary in relative length and in their relative position, sometimes closely fitting one over the other, sometimes drawn out with long tubular portions between the chambers. There is much difference in the materials used by various species, sand grains being the usual material, but certain species select sponge-spicules and in one species, *Reophax membranaceus* the test is composed largely of chitinous material.



FIGS. 111-113.—ASCHEMONELLA CATENATA. × 15 (AFTER BRADY).

## Genus REOPHAX Montfort, 1808.

*Reophax* MONTFORT (type, *R. scorpiurus* MONTFORT), Conch. Syst., vol. 1, 1808, p. 330, 83me genre.—H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 289.—EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 675.

*Nodosaria* D'ORBIGNY (not of LAMARCK, 1812) (part), Ann. Sci. Nat., vol. 7, 1826, p. 255.—TERQUEM, Mém. Acad. Imp. Metz, vol. 51, 1870, p. 354.

*Lituola* PARKER and JONES (part), Trans. Roy. Soc. London, vol. 155, 1865, p. 407.—PARKER, Can. Nat., vol. 5, 1870, pp. 177, 180.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 159.—SIDDALL, Proc. Chester Soc. Nat. Sci., pt. 2, 1878, p. 47.—BÜTSCHLI, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 192.

*Haplostiche* SCHWAGER (not of REUSS, 1861), Jahresh. Ver. vat. Naturk. Württemburg, vol. 21, 1865, p. 92.

*Nodulina* RHUMBLER, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 85.

*Description.*—Test free, composed of a linear series of chambers, joined end to end in a nearly straight line, sometimes slightly curved or irregular but not coiled, wall coarsely arenaceous, chambers undivided, aperture simple and terminal.

This genus as now modified includes the multiple chambered uniserial arenaceous forms with undivided chambers and a single oral aperture.

### REOPHAX SCORPIURUS Montfort.

"*Orthoceras*" ?, Soldani, Testaceographica, vol. 1, 1795, p. 239, pl. 162, fig. K.

*Reophax scorpiurus* Montfort, Conch. Syst., vol. 1, 1808, p. 330, 83me genre.—W. B. Carpenter, The Microscope, 6th ed., 1881, p. 564, fig. 321*e*.—H. B. Brady, Denkschr. kais. Akad. Wiss. Wien, vol. 42, 1881, p. 99.—Haeusler, Quart. Journ. Geol. Soc., vol. 39, 1883, p. 27, pl. 2, fig. 7.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 291, pl. 30, figs. 12–17.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 328, pl. 13, figs. 5 *a*, *b*.—Haeusler, Neues Jahrb. für Min., Beil., vol. 4, 1885, p. 9, pl. 1, figs. 9–16.—A. Agassiz, Bull. Mus. Comp. Zoöl., vol. 15, 1888, p. 163, fig. 495 (in text).—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 217, pl. 41, fig. 10.—Haeusler, Abh. schweiz. pal. Ges., vol. 17, 1890, p. 27, pl. 5, figs. 23, 24.—J. Wright, Proc. Roy. Irish Acad., vol. 1, 1891, p. 467.—Chapman, Journ. Roy. Micr. Soc., 1892, p. 320, pl. 5, figs. 4, 5.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 257, pl. 4, fig. 18; pl. 5, figs. 45, 46.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 24, pl. 5, figs. 158–163; pl. 6, figs. 164–167 [not 168–171].—Chapman, Proc. Zool. Soc. London, 1895, p. 14.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 26.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 273, pl. 16, fig. 3.—Millett, Journ. Roy. Micr. Soc., 1899, p. 254.—Guppy, Proc. Victoria Inst., Trinidad, vol. 2, 1902, p. 3, pl. 2, fig. 2.—Chapman, Trans. and Proc. New Zealand Inst., vol. 38, 1906, p. 84.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 126.

*Nodosaria* (*Dentalina*) *scorpionus* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 255, No. 40.

*Lituola scorpiurus* H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 467, pl. 48, fig. 5.—Nat. Hist. Trans. Northumberland, vol. 1, 1867, p. 96, pl. 12, fig. 3.—Dawson, Can. Nat., vol. 5, 1870, p. 177, fig. 4.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 159, pl. 9, fig. 29.—Dawson, Amer. Jour. Sci., vol. 1, 1871, p. 206, fig. 4; Ann. Mag. Nat. Hist., ser. 4, vol. 7, 1871, p. 86, fig. 4.

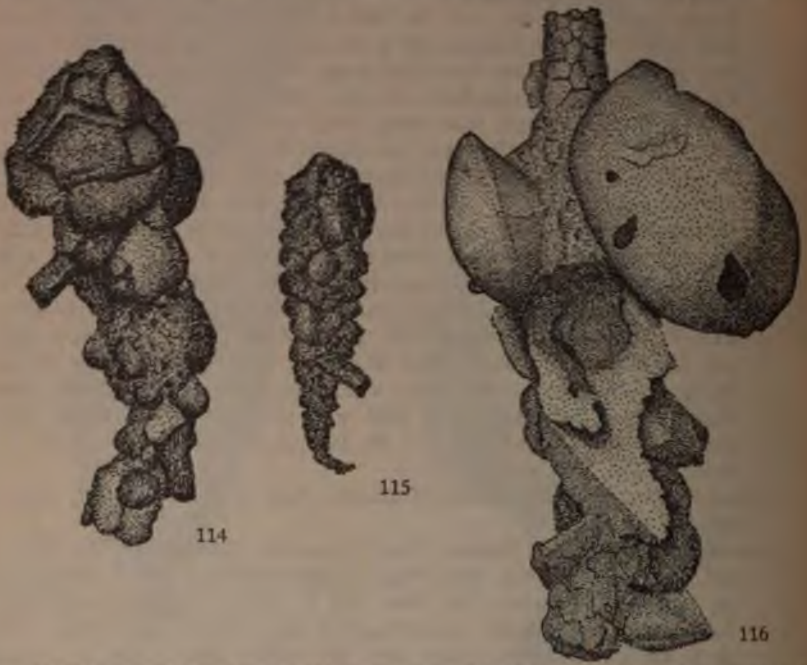
*Lituola nautiloidea*, var. *scorpiurus* Parker and Jones, Trans. Roy. Soc. London, 1865, p. 407, pl. 15, fig. 48 *a*, *b*.—H. B. Brady, Pal. Soc. Monogr., vol. 30, 1876, p. 63, pl. 8, fig. 7.—Schwager, Boll. Reg. Com. Geol. Ital., vol. 8, 1877, p. 26, fig. 87.—Bütschli, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 192, pl. 5, fig. 18.

*Description.*—Test consisting of a number of chambers, rapidly increasing in size as added, early chambers irregularly arcuate, later ones more nearly straight, surface rough, of fairly large sand grains, aperture simple, with a short neck, small.

Length 0.5–2 mm.

*Distribution*.—This species is recorded by Brady at seven *Challenger* stations from 40 fathoms on the coral reefs of Honolulu to 3,950 fathoms in the abyssal region east of Japan. Goës records it from *Albatross* station D3431, 995 fathoms at the entrance to the Gulf of California as scarce. Bagg records it from three stations near the Hawaiian Islands, 495–1,307 fathoms. I have found it in North Pacific material, from about Japan at a number of stations, and from the vicinity of Hawaii, usually in rather shallow water in both regions.

Of Bagg's specimens, only one, that from station D4567, can belong to this species. Of the other two specimens, one is not *Reophax*, the other very questionable. Some of the Goës material is typical, some of it rather nondescript.



FIGS. 114-116.—REOPHAX SCORPIURUS, 114, SPECIMEN FROM HAWAIIAN ISLANDS, 114 FATHOMS. × 2 115, SPECIMEN FROM OFF JAPAN, 77 FATHOMS. × 15. 116, SPECIMEN OF QUESTIONABLE CHARACTE FROM HAWAIIAN ISLANDS, 217 FATHOMS. × 10.

A review of the above synonymy will show that this specific name has been a sort of dumping ground for every irregular arenaceous Foraminifer or worm tube which is not definitely coiled or not well characterized. The original figure of Soldani on which Montfort based this species shows an arenaceous test with the early chambers irregularly arcuate, the later ones nearly straight and larger. Montfort made a fanciful copy of this figure of Soldani and the result is rather surprising, the figured specimens being made to show a network of raised ribs which were the lines between the sand grains in

Soldani's figure. With such a copy and the subsequent figures showing all sorts of arenaceous tests it is no wonder that there has existed great confusion in regard to this species.

The species is here restricted to those specimens showing the typical structure, such as Goës, 1894, pl. 5, fig. 158; pl. 6, figs. 164, 166, 167, and Flint, 1899, pl. 16, fig. 3.

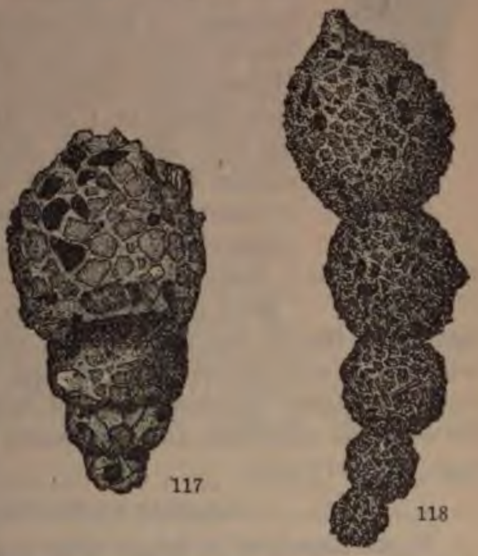
### REOPHAX PILULIFER H. B. Brady.

*Reophax pilulifera* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 292, pl. 30, figs. 18-20.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, pt. 7, 1888, p. 217, pl. 41, figs. 5-7 [8?].—Chapman, Proc. Zool. Soc. London, 1895, p. 15.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 27.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 273, pl. 18, fig. 1.

*Description.*—Test composed of few (three to five) chambers, arranged in a straight or slightly arcuate line, chambers subglobose, each much larger than the preceding, walls of coarse sand grains, but rather neatly cemented with considerable cement, giving a fairly smooth exterior, aperture small, often with a slight neck-like protuberance.

Length up to 2.5 mm.

*Distribution.*—In the *Challenger* material from the North Pacific this species occurs at stations 237 and 244, 1,875 and 2,900 fathoms, east of Japan. Goës found it in the *Albatross* material at station D3419, in 772 fathoms, in the eastern tropical Pacific, not 1,800 fathoms as he recorded it. His selected material consists of ten specimens from this station, a typical one of which is here figured. I have found two specimens from *Albatross* station D4957, in 437 fathoms, south of Japan. The figures given by Goës in 1894 are really *R. guttifer* H. B. Brady. Fig. 8, at least, of Brady, Parker, and Jones, 1888, is very questionable.



Figs. 117-118.—Reophax pilulifer. 117, specimen from series selected by Goës. × 20. 118, another specimen. × 35.

### REOPHAX DISTANS H. B. Brady.

*Reophax distans* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 50; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 296, pl. 31, figs. 18-22.—Chapman, Proc. Zool. Soc. London, 1895, p. 15.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 27.

*Description.*—Test composed of a few fusiform chambers with long slender connections in a straight line or irregular, usually not more than three chambers found together, wall of coarse sand grains, but rather smoothly cemented, thin.

Length of three chambered specimens, 5 mm.

*Distribution.*—The *Challenger* obtained this species from four North Pacific stations, 1,875–2,050 fathoms, between Japan and 180°. Goës records it from three *Albatross* stations off the west coast of Mexico and Central America, station D3419, 772 fathoms; D 3399, 1,740 fathoms; D3375, 1,201 fathoms. I have found single chambers in material from the stomachs of Holothurians taken at *Albatross* station D3603 in 1,771 fathoms, in Bering Sea; also single chambers at *Nero* station 1012, in 1,932 fathoms, north of Guam. The figured specimen is from *Albatross* station D3375.

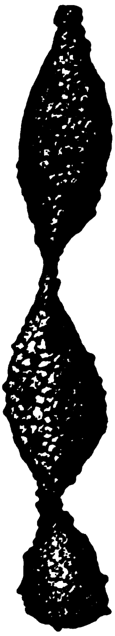


FIG. 119.—REOPHAX DISTANS. × 40.

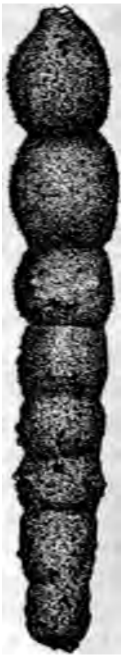


FIG. 120.—REOPHAX BACILLARIS. × 15.

Goës speaks of this material as "more globiform" than the specimens figured by Brady, but the material of Goës that I have examined

*Albatross* stations D3375, D3376, 1,132 and 1,201 fathoms. I have examined his material from the latter station, two specimens, each with eight chambers, evidently not complete, but of the typical form. One of these specimens is figured (fig. 120).

### REOPHAX DENTALINIFORMIS H. B. Brady.

*Reophax dentaliniformis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 49; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884. p. 293, pl. 30, figs. 21, 22.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 25, pl. 6, figs. 172–175.—SCHLUMBERGER, Mém. Soc. Zool. France, vol. 7, 1894, p. 239.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 15.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 27.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 274, pl. 18, fig. 2.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 254.

*Reophax nodulosa* BAGG (not H. B. BRADY), Proc. U. S. Nat. Mus., vol. 34, 1908, p. 23.

*Description.*—Test slender, tapering, composed of a few (five or six) elongated chambers, but slightly tumid in the middle, in a straight or slightly curved line, walls composed of rather coarse sand grains but very neatly cemented together, giving a fairly smooth exterior, aperture rather large, at the end of the short tubular neck; color gray.

Length up to 2 mm.

*Distribution.*—This species is now known from fifteen stations in the North Pacific, down to 3,950 fathoms off Japan. Schlumberger records the species from the Okhotsk Sea and the other stations cover rather well the area south of lat. 40° N. from the coast of Japan to the Hawaiian Islands and off the west coast of Mexico and Central America.

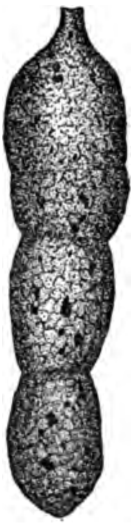


FIG. 121.—REOPHAX DENTALINIFORMIS. × 20.

Goës's specimens from Station D3276, 1,132 fathoms, are for the most part complete and typical. The specimen referred by Bagg to *Reophax nodulosus* is really a specimen of *R. dentaliniformis* H. B. Brady.

### REOPHAX NODULOSUS H. B. Brady.

*Reophax nodulosus* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 52, pl. 4, figs. 7, 8; Denkschr. kais. Akad. Wiss. Wien, vol. 42, 1881, p. 99; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 294, pl. 31, figs. 1-9.—TOUTKOWSKI, Zap. Kievsk. obshch. Est., vol. 9, 1888, p. 5, pl. 2, figs. 2 *a*, *b*.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 256, pl. 4, figs. 5–7, 12, 13 [?].—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 26, pl. 6, figs. 187-191.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 15.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 27.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 274, pl. 18, fig. 4.

*Description.*—Test elongate, tapering, usually straight but sometimes arcuate, consisting of several chambers (usually less than twelve) pyriform in shape, the proximal part of each broadest, thence tapering gently toward the distal end, gradually increasing in size toward the distal end of the test, in the large form with short chambers, roughi form with long chambers, smooth; aperture the end of the tapering chamber; color usuall

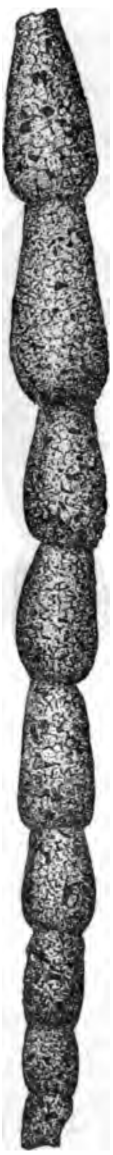


FIG. 122.—REOPHAX NODULOSUS. × 25.

Length very variable, up to 25 mm.

*Distribution.*—There are ten published re this species which with the new stations *Albatross* and *Nero* soundings give a very ge tribution for this species in the North Pacifi ranging from 941–3,950 fathoms.

Bagg's specimen from *Albatross* statio assigned to this species is *Reophax denta* H. B. Brady, as I find upon examination o terial. Goës's specimens, as well as all oth Pacific material that I have seen, are like pla 3 and 4 of the *Challenger* Report. Some specimens had nine chambers. His specim the Caribbean Sea are more like figures 6–8 of plate, and it is very probable that Brady has more than one species under this name. E ures seem to represent a mixed assemblage character, none of which appears to be a ty *phax nodulosus.*

### REOPHAX GUTTIFER H. B. Brady.

*Reophax guttifera* H. B. BRADY, Quart. Journ. Mic 21, 1881, p. 49; Proc. Roy. Soc. Edinburgh, v p. 711; Rep. Voy. *Challenger*, Zoology, vol. 9, 1 pl. 31, figs. 10–15.—GOËS, Kongl. Svensk. Handl., vol. 25, no. 9, 1894, p. 26, pl. 6, figs.

*Reophax pilulifer* GOËS (not H. B. BRADY), Kon Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 25 176–180.

*Description.*—Test elongate, nearly straig posed of from 3–8 chambers, typically pyrifor est at the base and rather rapidly narrowi aperture at the distal end of the chamber, posed of coarse sand grains, rather roughly c color yellowish-brown.

Length up to 1.6 mm.

*Distribution.*—With the exception of the P the only records for the North Pacific for this species are *Challenger* material, stations 237 and 246, 1,875 and 2,050

The narrow stolon-like connections between the chambers make the test very fragile and probably account for the fact that specimens with slender connections are composed of few chambers. Goës's figures are very small and it is difficult to determine exactly what he had. Goës's figures of *R. pilulifer* are apparently *R. guttifer*, as near as one can make out.

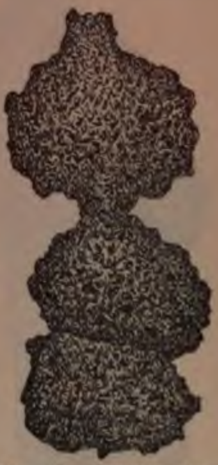


FIG. 123.—REOPHAX GUTTIFER. × 100.

### REOPHAX INSECTUS Goës.

*Reophax insectus* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 28, pl. 3, figs. 6, 7.

*Description.*—Test stout, tapering, consisting of several short, inflated chambers, each larger than the preceding one, wall composed of large sand grains and rather rough on the exterior; circular in end view; light gray in color.

Length 5–8 mm., the last chamber often 2 mm. in diameter.

*Distribution.*—Goës described this species from material from *Albatross* stations off the west coast of Mexico and near the Galapagos Islands, *Albatross* stations D3407, D3419, and D3431, in 772–995 fathoms. Besides seeing the original material and finding additional specimens at the last station, I have found two specimens from *Albatross* station D4337, in 617–680 fathoms off San Diego, California. The material from this station was very similar to that from farther south, and might equally well be termed "Rhabdammina ooze."

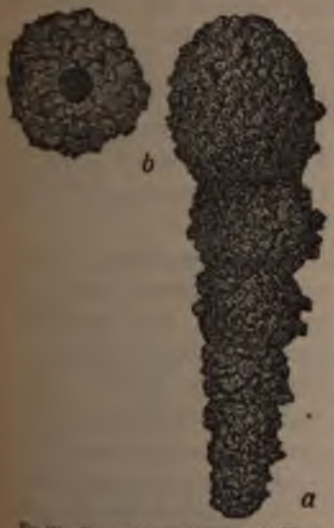


FIG. 124.—REOPHAX INSECTUS. × 12. *a*, SIDE VIEW; *b*, END VIEW.

### REOPHAX ADUNCUS H. B. Brady.

*Reophax adunca* H. B. BRADY, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 715; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 296, pl. 31, figs. 23–26.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 274, pl. 18, fig. 5.

*Description.*—Test consisting of several subglobular chambers in an irregular line, constrictions between the chambers slight, walls thin, composed of rather coarse sand grains giving a rough exterior, length indefinite, 2 mm. or more.

*Distribution.*—The only North Pacific records for this species are from *Challenger* stations 237, 244, 246, and 256, 1,875–2,950 fathoms, all curiously enough between lat. 30° and 40° N.

This differs from the other species of *Reophax*, and when its early development is known, may be placed elsewhere. It has the appearance of the later chambers of certain attached species which later become free or coiled species, straightening out in their later development. Flint's figures show specimens of identical character with those obtained by the *Challenger*.

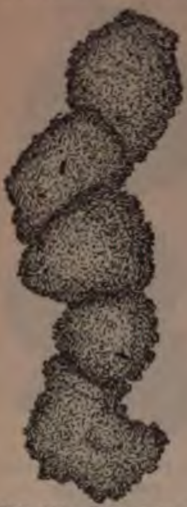


FIG. 125.—REOPHAX ADUNCUS. × 50.

### REOPHAX MEMBRANACEUS H. B. Brady.

*Reophax membranacea* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 53, pl. 4, fig. 9; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 297, pl. 32, figs. 1–4.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 255, pl. 4, fig. 14.

*Description.*—Test elongate, slender, tapering, straight or slightly curved, consisting of from five to ten subcylindrical, elongated chambers, slightly tumid in the middle; walls thin, chitinous, of a brown color; length up to 1.4 mm.

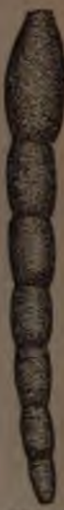


FIG. 126.—REOPHAX MEMBRANACEUS. × 200.

*Distribution.*—Brady records this species from *Challenger* station 238 in 3,950 fathoms off Japan and in the volume on the "Summary of Results" it is questionably recorded from the next station, 237, in 1,875 fathoms. I have found specimens in material from three *Nero* stations, 1012, 1021, 1030, in 1,932–2,112 fathoms, north of Guam. Specimens were very rare.

These specimens, one of which is figured here, are more like the specimens figured by Brady than those figured by Millett. The walls are very thin and clean.

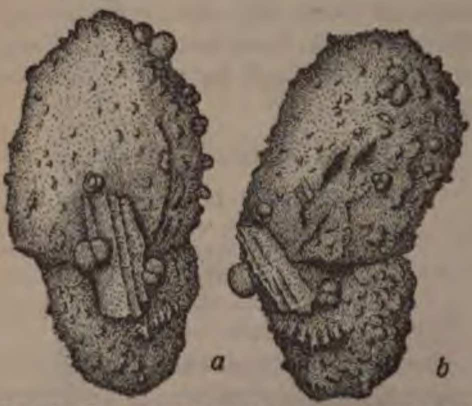


FIG. 127.—REOPHAX BILOCULARIS. × 25, *a*, FRONT VIEW; *b*, SIDE VIEW SHOWING THE OBLIQUITY OF THE CHAMBERS.

### REOPHAX BILOCULARIS Flint.

*Reophax bilocularis* FLINT, Rep. U.S. Nat. Mus., 1897 (1899), p. 273, pl. 17, fig. 2.

*Description.*—Test composed of two chambers in a straight line or set at an angle, chambers oval, walls of foreign matter, sand and largely of tests of other Foraminifera, surface irregular, aperture at the end of a tubular neck.

Length up to 2.5 mm.

*Distribution.*—I have found a single specimen from *Nero* station 1464, in 891 fathoms in globigerina ooze. This station is just north of Guam. The specimen appears to belong to this species. It has two chambers of an oval shape, set at a slight angle. The wall made up of a small part of sand with tests of other Foraminifera and other foreign material making up the rest.

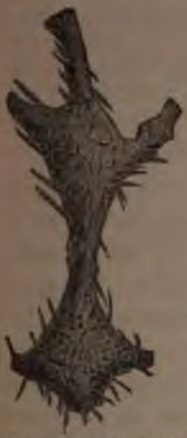
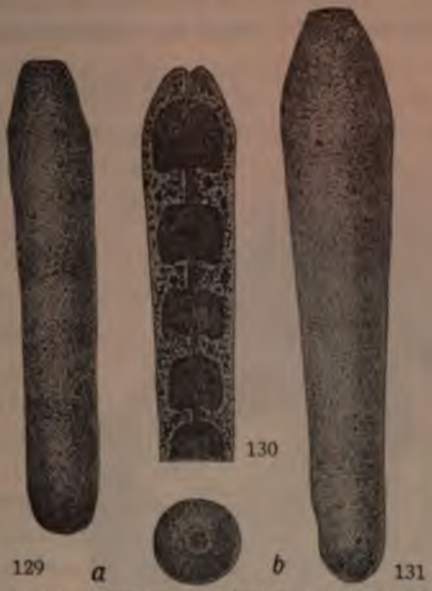


Fig. 128.—Reophax armatus. × 22 (after Goës).



Figs. 129-131.—Reophax cylindricus. × 20 (after Brady). 129 *a*, side view; *b*, apertural view. 130, longitudinal section. 131, side view.

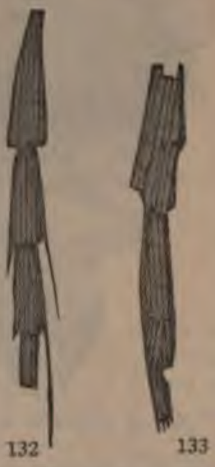
### REOPHAX ARMATUS Goës.

*Reophax armatus* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 29, pl. 1, fig. 1.

There are no specimens of this peculiar form in the material returned to the National Museum by Goës. From his figure and description it is difficult to determine just what was the character of Goës's specimens. The Pacific specimen was from *Albatross* station D3415 in 1,879 fathoms, off the coast of Mexico.

### REOPHAX CYLINDRICUS H. B. Brady.

*Reophax cylindrica* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 299, pl. 32, figs. 7-9.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 257, pl. 4, fig. 37 [?].—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 274, pl. 18, fig. 6.



Figs. 132-133.—Reophax spiculifer. × 50 (after Brady).

This species is recorded in the volume of the *Challenger* report on the "Summary of Results," from station 237, 1,875 fathoms, east of Japan. The record is followed by a question mark, as though there were some doubt about the correctness of the determination.

### REOPHAX SPICULIFER H. B. Brady.

*Reophax spiculifera* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 54, pl. 4, figs. 10, 11; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 295, pl. 31, figs. 16, 17.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 258, pl. 4, fig. 19 (?).—Chapman, Proc. Zool. Soc. London, 1895, p. 14.

*Description.*—Test composed of a few chambers, broadest at the posterior end of each and gradually narrowing to the apertural end; wall composed of elongate sponge spicules arranged in general lengthwise of the chamber, often projecting back toward the posterior end of the chamber; aperture circular.

Length about 1 mm.

*Distribution.*—In the volume of the *Challenger* report on the "Summary of Results" this species is recorded with a question mark from stations 237 and 246, 1,875 and 2,050 fathoms. I have not met with it in the material I have examined from the North Pacific.

### REOPHAX EXCENTRICUS, new species.

*Description.*—Test small, composed of a nearly straight linear series of chambers, the size rapidly increasing with each newly added chamber; wall composed of sand grains, rather neatly cemented together; aperture at the end of a short tubular neck at one side of the axis of the test, varying somewhat in the amount of its eccentricity; color gray.

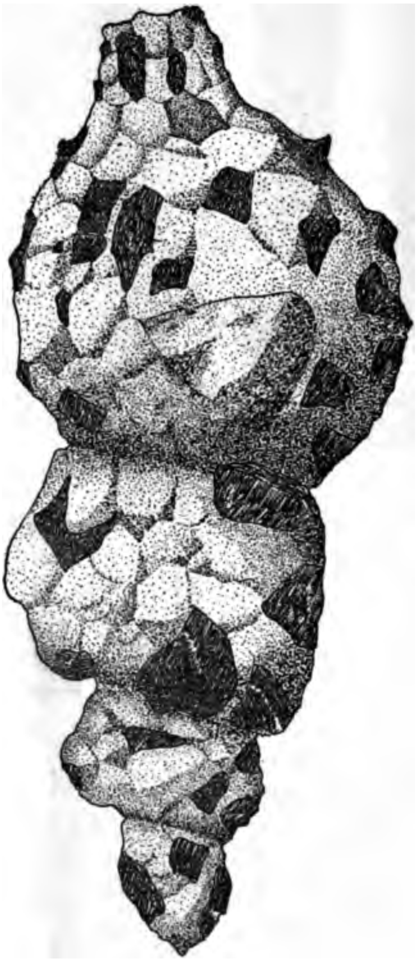


Fig. 134.—Reophax excentricus. × 80.

*Type-specimen.*—Cat. No. 8261, U.S.N.M., from *Albatross* station D3603, from the stomachs of Holothurians dredged in 1,771 fathoms in Bering Sea.

### REOPHAX CATENULATUS, new species.

*Description.*—Test consisting of a series of subglobular chambers of large size connected by rather slender tubular portions, walls of coarse sand grains very roughly cemented, color gray or yellowish-brown.

Length of three chambers, 7 mm.; diameter of largest chamber, 1.8 mm.

*Type-specimen.*—Cat. No. 8262, U.S.N.M., from *Albatross* station D4965 in 191 fathoms, off the southern coast of Japan.

This is one of the largest species of the genus and the exterior is very rough.

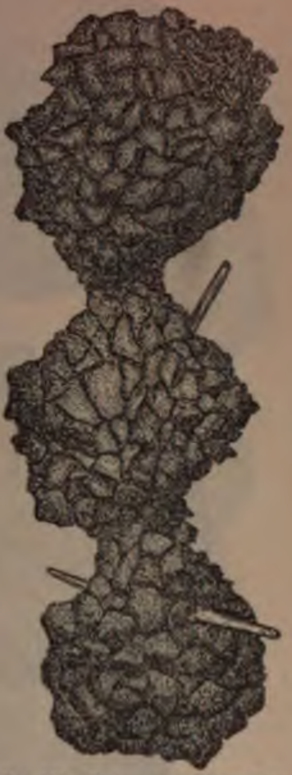


Fig. 135.—Reophax catenulatus. × 25.

## Genus HORMOSINA H. B. Brady, 1879.

*Hormosina* H. B. Brady (type, *H. globulifera* H. B. Brady), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 56.—Bütschli, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 199.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 325.

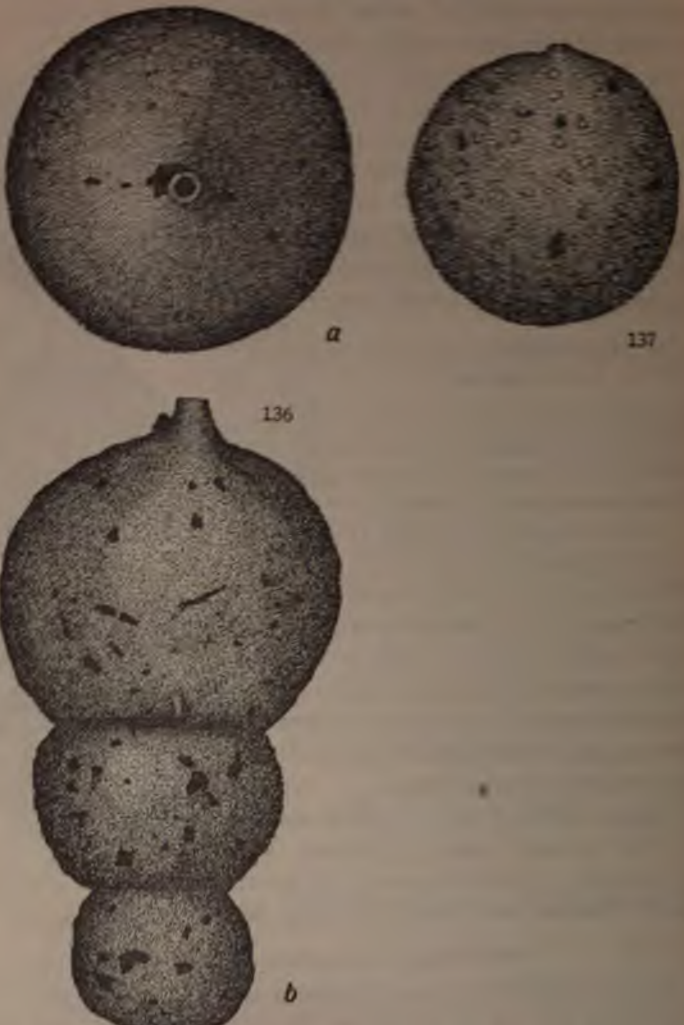
*Description.*—Test free, composed of a series of subglobular, fusiform or pyriform chambers joined end to end in a single moniliform series, walls thin, finely arenaceous, chambers undivided, aperture a single circular opening at the distal end of the neck of the chamber, color brownish.

This genus differs from *Reophax* mainly in its fine texture, smooth surface, and brown cement. Several species occur in the North Pacific, but usually in fairly deep water.

### HORMOSINA GLOBULIFERA H. B. Brady.

*Hormosina globulifera* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 60, pl. 4, figs. 4, 5.—W. B. Carpenter, The Microscope, 6th ed., 1881, p. 563, fig. 320c (in text).—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 326, pl. 39, figs. 1-6.—De Folin, Le Naturaliste, vol. 10, 1888, p. 87, figs. 1, 2.—J. Wright, Proc. Roy. Irish Acad., vol. 1, 1891, p. 468.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 29, pl. 6, figs. 218, 219.—Chapman, Proc. Zool. Soc. London, 1895, p. 17.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 34.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 280, pl. 24, fig. 4.

*Description.*—Test composed typically of a few subglobular chambers, each larger than its predecessors and more or less embracing it, arranged in a straight or slightly arcuate line, aperture small, at the end of a definite, tubular neck, walls finely arenaceous, thin, surfac smooth both within and without; color, light brownish.



FIGS. 136-137.—HORMOSINA GLOBULIFERA. 136*a*, END VIEW SHOWING APERTURE; *b*, FRONT VIEW. × 137, SINGLE CHAMBERED FORM, × 40.

Length about 3 mm.

*Distribution.*—In the *Challenger* material this species occurred four North Pacific stations, 237, 241, 244, 246, in 1,875–2,900 fa oms, all on the eastward voyage from Japan to the mid-Paci Goës records the species from four *Albatross* stations in the east ical Pacific, D3375, D3376, D3407, D3415, in 888–1,879 fathoms. figured specimen is from the Goës material from Station D3415. oës speaks of the specimens as not quite typical, but his specis agree very well with Brady's figures and description.

**HORMOSINA OVICULA H. B. Brady.**

*Hormosina ovicula* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 61, pl. 4, fig. 6.—Bütschli, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 199, pl. 5, fig. 15.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 327, pl. 39, figs. 7-9.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 29, pl. 6, figs. 220, 221.—Chapman, Proc. Zoöl. Soc. London, 1895, p. 17.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 280, pl. 25, fig. 2.

*Hormosina ovicula*, var. Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 34, pl. 4, fig. 3.

*escription.*—Test composed of several fusin chambers joined end to end with slender nective portions, in a straight or slightly ved line, wall thin, finely arenaceous, color owish-brown with a distinctly darker redbrown portion at the distal end of the neck ach chamber.

ength up to 4 mm.

*istribution.*—There are four *Challenger* rec for this species, station 206, in 2,100 fath, west of Luzon, stations 237, 238, 246, in '5–3,950 fathoms, on the line east from Ja. Goës records the species from two *Alba* stations off the west coast of Mexico and tral America, D3357 in 789 fathoms and 15 in 1,879 fathoms, the specimens being ll and scarce.

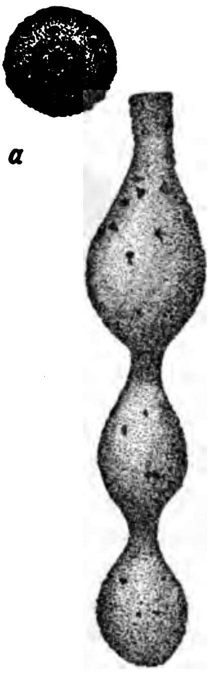


Fig. 138.—Hormosina ovicula. × 45. *a*, end view showing aperture; *b*, side view.

oës speaks of the material as not typical, but while the specimens n the Caribbean Sea are not typical that from the Pacific is much e so. The figured specimen is from *Albatross* station D3915 is very typical, even to the color bands of the neck of each mber.

**HORMOSINA NORMANII H. B. Brady.**

*Hormosina normanii* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 52; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 329, pl. 39, figs. 19–23.

*escription.*—Test composed of a few subspherical segments, earlier s small, later ones much larger, irregularly arranged, aperture at end of a tubular neck often near the entrance of the last previous rture or at one side, walls very thin, smooth both without and hin.

Length, 8 mm.

*Distribution.*—In the *Challenger* material this species occurs at three stations, 241, 244, 246, at 2,300, 2,900, and 2,050 fathoms, respectively, all in the one line of soundings east from Japan.

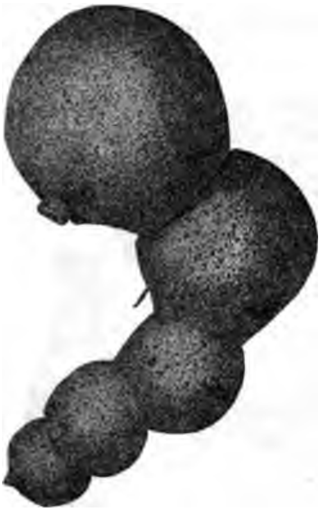


FIG. 139.—HORMOSINA NORMANII. × 10. (AFTER BRADY.)

### Genus HAPLOSTICHE Reuss, 1861.

*Nodosaria* (part) D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 252.—REUSS, Vers. böhm. Kreide, vol. 1, 1845–1846, p. 26, pl. 13, figs. 12–13.

*Lituola* (part) JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 307.

*Haplostiche* REUSS, Sitzb. kön. böhm. Ges. Wiss., Jahrg. 1861, p. 16.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 317. Type, *H. fœdissima* REUSS, 1865.[a]

*Description.*—Test free, cylindrical, composed of a linear series of chambers, variously divided into labyrinthic cavities; walls thick, coarsely arenaceous but usually fairly smooth on the exterior; aperture in the middle of the terminal face, in the early chambers simple, in the adult made up of several pores or dendritic.

There seems to be but a single recent species occurring in shallow or medium depths usually in tropical or subtropical waters.

#### HAPLOSTICHE DUBIA (d'Orbigny).

ases the divisions are separated, giving several openings; color le, usually light gray.

gth up to 7.5 mm.; diameter up to 2 mm.

*ribution.*—The only published record for this species in the Pacific is that of Bagg, who recorded it from two *Albatross* s in the vicinity of the Hawaiian Islands, D4000 in 104–213 s and H4590 in 978 fathoms. I have found ens in material from *Nero* station 2071 in 271 s, also near the Hawaiian Islands and at *Alba*-ation D. 4900 in 139 fathoms off Japan.

dendritic aperture is supposed to distinguish ecies from any others that may be confused with in the smaller specimens which have not attained characters the aperture is simple. The laby- condition of the interior is also characteristic.

140 141

FIGS. 140–141.—HAPLOSTICHE DUBIA × 7. FROM PHOTOGRAPH.

rbigny's name is the first to be referred to the figure of Sol- riority will make necessary the use of his name *dubia* instead *anii* Jones and Parker.

## Subfamily 3. TROCHAMMININÆ.

composed of several chambers, either in a planospiral coil, id, or otherwise arranged, wall composed of sand grains of g degrees of coarseness cemented with a calcareous or ferru- cement, free or attached.

subfamily as here used contains the many-chambered arenace- rms not arranged in a linear series throughout. Except the somewhat anomalous form, *Neusina agassizii*, for which a te subfamily has been made. Some of the species, such as *baculites tenuimargo*, appear to be largely made up of a linear but have a close coiled early portion not seen in the Reo-
æ.

## TROCHAMMINOIDES, new genus.

*ription.*—Test free, typically planospiral, composed of several ach constricted into a number of chamber-like portions with enings between large; wall of fine sand and a yellowish-brown t; aperture simple at the end of the last-formed chamber.

*e of the genus.*—*Trochammina proteus* Karrer.

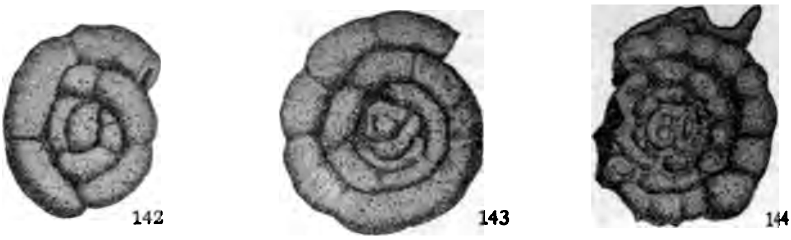
species frequently shows a tendency to continue the *Ammo*- condition through one or more of the early coils, and the latter only may be divided, or in other specimens the divisions may much earlier. By its early development the genus is seen to een derived from an *Ammodiscus* condition, as its early devel- t consists of a proloculum and long coiled chamber as in *liscus*, but its later constricted condition foreshadows the con- of complete division seen in the chambered coiled forms assigned to *Haplophragmium* and *Trochammina*.

### TROCHAMMINOIDES PROTEUS (Karrer).

*Trochammina proteus* KARRER, Sitzb. kais. Akad. Wiss. Wien, vol. 52 (Abth. 1), 1865 (1866), p. 494, pl., fig. 8 (not 1-7).—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 341, pl. 40, figs. 1-3.—HAEUSLER, Neues Jahrb., Beil., vol. 4, 1885, p. 28, pl. 3, fig. 24 (25-27?).—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 266, pl. 5, figs. 7, 8 [?].—EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 694, fig. 42 (in text).—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 281, pl. 25, fig. 3.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 128.

*Ammodiscus proteus* RHUMBLER, Arch. Protistk., vol. 3, 1903, p. 281, fig. 131 (in text).

*Description.*—Test of several coils, usually planospiral, each coil usually constricted to form several chambers, but the early coils sometimes unconstricted, wall composed of fine sand and a yellowish-brown or reddish-brown cement, fairly smooth, chambers variable in length, aperture large, with thickened lips.



FIGS. 142-144.—TROCHAMMINOIDES PROTEUS. × 25 (AFTER BRADY).

Diameter 1-1.5 mm.

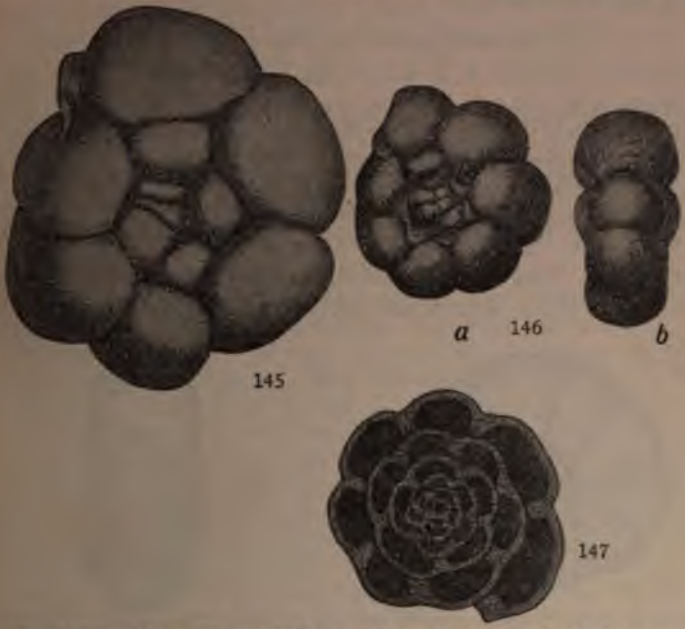
*Distribution.*—There are but two records for this species in the North Pacific, one *Challenger* station 224 in 1,850 fathoms, west of the

## Genus HAPLOPHRAGMOIDES, new genus.

*Description.*—Test free, planospiral, composed of several coils, ich composed of a number of chambers, wall arenaceous, varying uch in texture and in the relative amount of cement in the different pecies, aperture at the ventral border or on the lower portion of the pertural face of the chamber.

*Type of the genus.*—*Haplophragmium canariense* d'Orbigny.

Included in this genus are the various completely coiled, planopiral, arenaceous species with simple apertures which have usually



ios. 145-147.—Haplophragmoides coronata. × 20 (after Brady). 145, large specimen from side. 146 *a*, from side; *b*, apertural view. 147, section.

een assigned to *Haplophragmium* or *Trochammina*. The typepecies of the former genus is an uncoiled form with multiple aperures, and the type-species of the latter genus has a trochoid spiral est. As here recognized, the species of this new genus have approxinately an equal portion of the chambers of the test visible from the wo sides. I have included here both the species with an excess of ement often assigned to *Trochammina* and those of coarser texture, hich have been assigned to *Haplophragmium*.

### HAPLOPHRAGMOIDES CORONATA (H. B. Brady).

*Trochammina coronata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 58, pl. 5, fig. 15; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 340, pl. 40, figs. 10–12.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 281, pl. 26, fig. 3.

*Description.*—Test planospiral, fairly smooth, composed of three o six coils, the outer ones somewhat embracing, but all more or less visible from either side, chambers somewhat inflated, usually six seven in the last-formed coil, distinct; aperture simple, at the vent border of the apertural face, sometimes with traces of a lip prese wall composed of fine sand, usually with a reddish cement, but ve variable in color, from white to brown.

Diameter 2–2.5 mm.

*Distribution.*—The only record for this species in the North Paci is that of the *Challenger*, station 238, in 3,950 fathoms, east of Jap This is the deepest sounding of the *Challenger* expedition from whi material was examined.

### HAPLOPHRAGMOIDES TRULLISSATA (H. B. Brady).

*Trochammina trullissata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, 56, pl. 5, figs. 10 *a*, *b*, 11; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 3 pl. 40, figs. 14–16 (not fig. 13).—Haeusler, Abh. schweiz. pal. Ges., vol. 1890, p. 64, pl. 10, figs. 9, 11.—Egger, Abh. kön. bay. Akad. Wiss. Münch vol. 18, 1893, p. 265, pl. 5, figs. 25, 26 [?].—Chapman, Proc. Zool. Soc. Lond 1895, p. 18.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 33.—Mill Journ. Roy. Micr. Soc., 1899, p. 364.

*Description.*—Test spirally coiled, made up of about three coils, n completely involute, somewhat umbilicate, so that the chambers

As a rule, this seems to be a decidedly deep-water species as the additional records of this work confirm. Specimens never seem to be plentiful, occasional specimens occurring in the washed material from these stations.

### HAPLOPHRAGMOIDES CANARIENSIS (d'Orbigny).

*Nonionina canariensis* d'Orbigny in Barker-Webb and Berthelot, Hist. Nat. Îles Canaries, vol. 2, pt. 2, Foraminifères, 1839, p. 128, pl. 2, figs. 33, 34.

*Placopsilina canariensis* Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 301, pl. 10, figs. 23, 24.

*Lituola canariensis* W. B. Carpenter, Parker, and Jones, Intr. Study Foram., 1862, pl. 6, figs. 39, 40, 41.—H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 472.—Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 19, 1877, pl. 13, figs. 26–29.

*Lituola nautiloidea*, var. *canariensis* Parker and Jones (part), Trans. Roy. Soc. London, vol. 155, 1865, p. 406, pl. 15, figs. 45a, b, pl. 17, figs. 92–95.

*Haplophragmium canariensis* Siddall and H. B. Brady, Cat. Brit. Rec. Foram., 1879, p. 4.—Bütschli, in Bronn's Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 192, pl. 5, fig. 17.—H. B. Brady, Denkschr. kais. Akad. Wiss. Wien, vol. 42, 1881, p. 99; Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 310, pl. 35, figs. 1–5.—Haeusler, Neues Jahrb., vol. 4, 1885, p. 12, pl. 1, figs. 17–20.—H. B. Brady, Parker and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 218, pl. 41, fig. 9.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 330.—Haeusler, Abh. schweiz. pal. Ges., vol. 17, 1890, p. 34, pl. 4, figs. 1–3.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 261, pl. 5, figs. 27–29.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 20, pl. 5, figs. 92–101.—J. Wright, Proc. Roy. Irish Acad., vol. 1, 1891, p. 468.—Chapman, Ann. Mag. Nat. Hist., ser. 6, vol. 16, 1895, p. 314, pl. 11, fig. 5; Proc. Zool. Soc. London, 1895, p. 16.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 30.—Millett, Journ. Roy. Micr. Soc., 1899, p. 359.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 277, pl. 20, fig. 3.—Chapman, Trans. New Zealand Inst., vol. 38, 1905 (1906), p. 84; Journ. Quekett Micr. Club, vol. 10, 1907, p. 126, pl. 9, fig. 3.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 126.

*Nonionina jeffreysii* Williamson, Recent Foraminifera of Great Britain, 1858, p. 34, pl. 3, figs. 72, 73.

*Haplophragmium jeffreysii* Berthelin, Foram. de Bourgneuf et Pornichet, 1878, p. 24, No. 20.

*Description.*—Test free, nautiloid, composed of several coils partially involute or almost completely so, umbilicated, chambers subglobular, somewhat compressed laterally, from six to nine in each coil, walls arenaceous, made up of sand in various degrees of coarseness, but even when coarse usually fairly smooth on the exterior, thin, aperture an elongated slit-like opening at the base of the apertural face of the chamber; color brown or gray, often when brown the last formed chamber may be gray.

Diameter, 0.75–2 mm.

*Distribution.*—There are a considerable number of records for this species in the North Pacific. The *Challenger* report gives seven stations ranging from 1,850–3,950 fathoms, with one station on the coral reefs of Honolulu at 40 fathoms. Goës records it at three *Albatross* stations off the coasts of Mexico and Central America in 660–1,879 fathoms. Flint records it from a single station, *Albatross* D3080, in 93 fathoms off the coast of Oregon. Bagg records it from two *Albatross* stations, H4566 in 572 fathoms and H4696 in 367 fathoms, both stations near the Hawaiian Islands. In the present work I have had specimens from *Albatross* station D3431 off California, D4965, D4993, D5068, 77–191 fathoms off the coast of Japan; *Nero* stations 1308, 1311, in 1,040 and 1,503 fathoms near the Bonin Islands. Specimens were also obtained from the stomachs of Holothurians taken at *Albatross* station D3608 in Bering Sea.

There is a considerable variation in the texture of the wall, some specimens being smooth and of very fine material, resembling certain species of *Trochammina*, while others are of much coarser material. In general, however, the exterior of the test is smoothly finished. A considerable variety of forms have been assigned to this species by various authors, but I have placed here only those specimens which have the somewhat compressed form with the rounded chambers, which are characteristic of d'Orbigny's type figure.

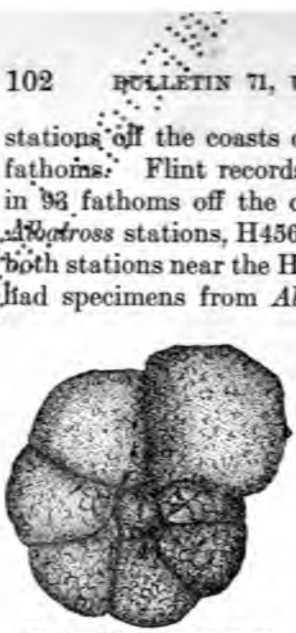


FIG. 149.—HAPLOPHRAGMOIDES CANARIENSIS. × 20.

HAPLOPHRAGMOIDES EMACIATUM (H. B. Brady).

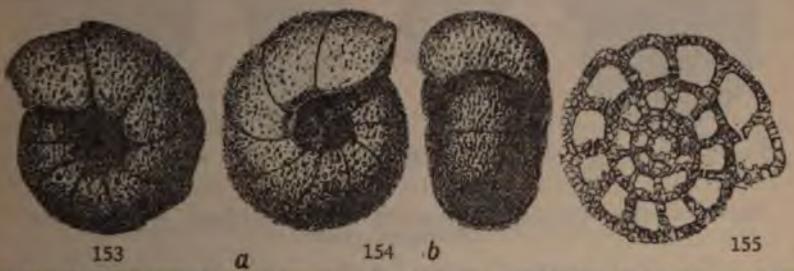
*Haplophragmium emaciatum* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 305, pl. 33, figs. 26–28.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 16.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 262, pl. 5, Midway Island. A single specimen from *Alert* station 1178 in 623 fathoms off San Augustino Island, belongs to this species.

From the series of specimens I have been able to obtain for study it seems a questionable point as to whether *H. compressum* of Goës is really the same as *H. emaciatum* H. B. Brady. As far as I have observed there is no tendency for any of the Pacific specimens to uncoil in later growth, and the aperture always remains a slit at the base of the apertural face. In the West Indian material which may be referred to *H. compressum* Goës there is a decided tendency to uncoil and a coincident change in the position of the aperture occurs. The specimen figured by Millet seems to be a close-coiled form and is included here.

### HAPLOPHRAGMOIDES SCITULUM (H. B. Brady).

*Haplophragmium scitulum* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 50; Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 711; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 308, pl. 34, figs. 11–13.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 16.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 276, pl. 20, fig. 2.

*Description.*—Test nautiloid, planospiral, consisting of about three coils, not completely involute so that at the umbilical region the earlier coils are exposed; wall composed of firmly cemented sand grains; from seven to eleven chambers make up the last-formed coil, the chambers being wide and broadly rounded at their peripheral edge give the whole test a much broader form than seen in *H. canariense;* chambers nearly flush with one another, giving a fairly even periphery to the test, aperture a somewhat curved slit at the base of the apertural face; color of the test various shades of brown.



FIGS. 153-155.—HAPLOPHRAGMOIDES SCITULUM. × 40 (AFTER BRADY). 153, SIDE VIEW. 154*a*, SIDE VIEW; *b*, APERTURAL VIEW. 155, SECTION.

Diameter 0.75–1 mm.

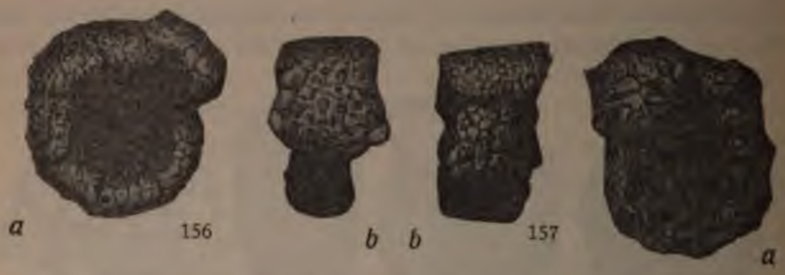
*Distribution.*—This species seems to be rare in the North Pacific. In the *Challenger* report it is recorded but once, from station 244 in 2,900 fathoms. Bagg records it from four *Albatross* stations in the vicinity of the Hawaiian Islands, 367–1,544 fathoms. I have seen material from but four other *Albatross* stations, D3431, at the entrance to the Gulf of California, 995 fathoms; H2774, off the California coast in 469 fathoms; D5018, in 100 fathoms in the Okhotsk Sea; and D4998 in 66 fathoms in the Gulf of Tartary off the southwestern coast of Sakalin Island, bottom temperature 35.9° F.

This species seems to be distinct from *H. canariense* and may be distinguished by its broader form, more deeply excavated umbilici, and the wider, flattened chambers.

### HAPLOPHRAGMOIDES ROTULATUM (H. B. Brady).

*Haplophragmium rotulatum* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 188, p. 50; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 306, pl. 34, figs. 5, 6.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 16.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 261, pl. 5, figs. 43, 44.

*Description.*—Test nautiloid, planospiral, composed of about three coils, wall fairly thick, of rather coarse sand particles, slightly rough on the exterior, chambers very broad and low, the peripheral margin much flattened, somewhat involute but the preceding coils exposed at the umbilical region, deeply concave on each side at the umbilici; chambers about nine in the last-formed coil, but rather indistinct when viewed from the exterior; aperture a narrow slit at the base of the apertural face; color brown.



FIGS. 156-157.—HAPLOPHRAGMOIDES ROTULATUM. × 50 (AFTER BRADY). *a*, *a*, FRONT VIEWS; *b*, *b*, APERTURAL VIEWS.

Diameter 0.56–0.75 mm.

*Distribution.*—Brady gives but a single North Pacific station, *Challenger* station 244 in 2,900 fathoms, but the volume on the "Summary of Results" adds two *Challenger* stations, 237 in 1,875 fathoms and 246 in 2,050 fathoms. The only specimen I have seen referable to this species is a single one from the coast of California, *Albatross* station H2681 in 486 fathoms, and this may perhaps be an extremely broad form of *H. scitulum*.

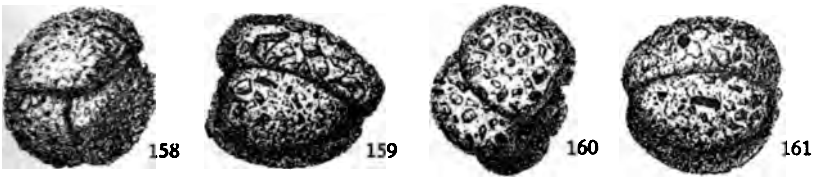
### HAPLOPHRAGMOIDES GLOMERATUM (H. B. Brady).

*Lituola glomerata* H. B. BRADY, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 433, pl. 20, figs. 1*a*–*c*.

*Haplophragmium glomeratum* WRIGHT, Proc. Belfast Field Club, 1880–81 (App.), p. 180, pl. 8, figs. 1, 1*a*.—H. B. BRADY. Denkschr. kais. Akad. Wiss. Wien, vol. 43, 1881, p. 100; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 309, pl. 34, figs.

15–18.—Balkwill and Millett, Journ. Micr. and Nat. Sci., vol. 3, 1884, p. 25, pl. 1, fig. 6.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 329.—J. Wright, Proc. Roy. Irish Acad., vol. 1, 1891, p. 468.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 23, pl. 5, figs. 134–136 [not figs. 137–139].—Chapman, Proc. Zool. Soc. London, 1895, p. 15.

*Description.*—Test planospiral, composed of about two coils, cham-
ers very low and broad making a subglobose test, usually three or
ur chambers making up the last-formed coil, slightly concave at
e umbilici, wall coarsely arenaceous, rather rough, thin; aperture



Figs. 158–161.—Haplophragmoides glomeratum. × 100 (after Brady).

the base of the apertural face consisting of a short slit which is
ten obscured by sand grains; color variable, depending largely upon
e material composing the test.

Diameter 0.25–0.75 mm.

*Distribution.*—Brady gives but one North Pacific *Challenger* station
r this species, off the Philippines in 2,550 fathoms. The volume
the "Summary of Results" also gives a record off Japan, *Chal-
nger* station 237 in 1,875 fathoms.

A number of specimens from *Nero* station 1295, in 1,415 fathoms
tween Yokohama and Guam, are possibly this species. Otherwise
have seen no North Pacific material referable to it.

### HAPLOPHRAGMOIDES SUBGLOBOSUM (G. O. Sars.)

*Lituola subglobosa* M. Sars, Forh. Vid. Selsk. Christiania, 1868 (1869), p. 250, (*nomen nudum*).—G. O. Sars, Forh. Vid. Selsk. Christiania, 1871 (1872), p. 253.

*Haplophragmium subglobosum* H. B. Brady, Denkschr. kais. Akad. Wiss. Wien, vol. 43, 1881, p. 100; Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 406.

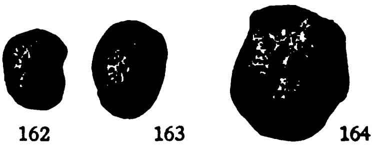
*Haplophragmium latidorsatum* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 307, pl. 34, figs. 7, 8, 10, 14 [?] (not fig. 9), and subsequent authors (not *Nonionina latidorsata* Bornemann, 1855).

*Description.*—Test usually planospiral consisting of two or more
ils, involute, depressed at the umbilici, chambers very broad and
w, wall arenaceous somewhat roughened but variable, chambers
ually seven or eight in the last-formed coil, making the test as a
hole subglobose, aperture a more or less elongated slit at the base
the apertural face, simple; color gray or brown.

Diameter 1–2.5 mm.

*Distribution.*—As *Haplophragmium latidorsatum* this species has
een widely recorded. There are given eleven *Challenger* stations in

the North Pacific for this species, ranging from 1,850–3,950 fathoms. Goës records it at several *Albatross* stations off the west coast of Mexico and Central America in 772–1,879 fathoms. Bagg gives four stations near the Hawaiian Islands, 367–1,342 fathoms. From the *Albatross* and *Nero* material I have examined this species is noted from many stations; *Albatross* D3603, from Holothurian stomachs, specimens taken in 1,771 fathoms in Bering Sea; from H3012 in 2,067 fathoms, between California and Hawaii; D4832, D4957, D4958 in 76, 437, and 405 fathoms, respectively. It occurred at a number of *Nero* stations in the dredgings from the Hawaiian Islands west across the Pacific, the depths varying from 1,040 to 2,226 fathoms.



FIGS. 162–164.—HAPLOPHRAGMOIDES SUBGLOBOSUM. × 16. FROM PHOTOGRAPH. 163. APERTURAL VIEW.

The work of Brady in referring to *Nonionina latidorsata* Bornemann the recent species so common in the Arctic has been followed by most later writers. After a careful study of Bornemann's original figure and description I am unable to find clear enough reasons for giving Bornemann's name to our species. The figure and description call for a test which has high compressed chambers with the apertural face quadrangular, while in recent specimens the apertural face of the last chamber is typically very much wider than high. The form of the test is usually more globose than in Bornemann's figure and the test presents a very different appearance. As it is definitely known what the

### HAPLOPHRAGMOIDES SPHÆRILOCULUM, new species.

*Description.*—Test free, nautiloid, planospiral, consisting of five chambers in the last-formed coil, partially involute, chambers very globose, inflated, sutures depressed, peripheral margin of test deeply indented, aperture at the base of the apertural face; wall of fine arenaceous material smoothly cemented; color yellowish-brown.

Diameter about 1 mm.

*Type-specimen.*—Cat. No. 8218 U.S.N.M., from *Albatross* station D4970 in 500 fathoms off Japan. Another specimen was found in material from *Albatross* station D4957 in 437 fathoms, also off Japan.

This species differs from other planospiral arenaceous forms in the spherical character and position of the chambers, which are well separated so that their globose character is given its full value in shaping the test.

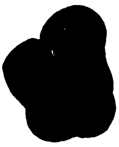


Fig. 165.—Haplophragmoides sphæriloculum. × 30. From photograph.

### HAPLOPHRAGMOIDES RINGENS (H. B. Brady).

*Trochammina ringens* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 57, pl. 5, figs. 12*a*, *b*; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 343, pl. 40, figs. 17, 18.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 33.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 281, pl. 27, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1899, p. 365, pl. 5, fig. 14 [?].—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 129.

*Ammochilostoma ringens* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 692.

*Description.*—Test spirally coiled, planospiral, of few coils, chambers usually completely involute covering the previously formed coils, chambers high, narrow, biconvex, usually with 3–5 in the lastformed coil; the lastformed chamber being much higher than preceding ones, peripheral edge somewhat sharp, surface smooth and polished, aperture slightly arcuate, somewhat above the base of the apertural face usually in a sort of depression of the wall; color various shades of brown.

Longer diameter 1.5 mm.

*Distribution.*—Although Brady states in his volume of the *Challenger* "Report" that the species seems to be limited to the Atlantic, in the volume on the "Summary of Results" this species is recorded from station 237, 1,875 fathoms, off Japan. Goës records this species as very scarce from a single *Albatross* station off Panama, D3375 in 1,201 fathoms. Flint records it from another *Albatross* station, D2923, in 822 fathoms off California.

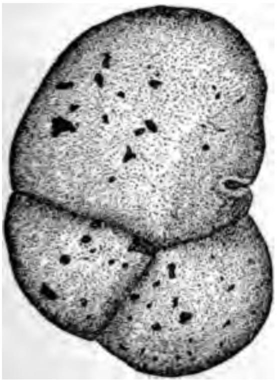


Fig. 166.—Haplophragmoides ringens. × 45.

Bagg records it from a single *Albatross* station near the Hawaiian Islands, H4590, in 978 fathoms, rare. I have found specimens from two North Pacific stations, *Albatross* D4979, off Japan, in 943 fathoms, and from *Alert* station 1156 in 2,046 fathoms south of Japan, near the Bonin Islands.

This seems to be a rare species and to occur in small numbers when found. In its earlier development the chambers are somewhat less flattened and of nearly equal height in the coil, but in the later development the chambers become high and the last-formed chamber in the adult is often much longer than any of the preceding ones.

The specimen figured by Millett is not typical, the last-formed chamber being of very different form from that usually seen in the specimens I have examined.

### CRIBROSTOMOIDES, new genus.

*Haplophragmium* H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 307.

*Description.*—Test free, planospiral, of several coils, chambered, the last-formed coil with several chambers progressively increasing in size, arenaceous wall, with much cement usually of a light-brown color, aperture in young specimens a simple elongate slit at the base of the apertural face, later subdivided by tooth-like processes, and in the adult represented by a linear series of distinct rounded openings.

*Type of genus.*—*Cribrostomoides bradyi*, new species.

This genus, while in general character is similar to *Haplophragmoides*, differs very distinctly in the apertural characters and in their and the United States, the species has occurred in quantity at *Albatross* station D3346 off Washington, 786 fathoms, and at station D3431 in the Gulf of California, 995 fathoms. As is the case with many of our west coast species of foraminifera, this species is again seen in material from the coast of Japan. It occurred at *Albatross* station D4975 in 712 fathoms, and D5078, in 514 fathoms. Specimens, possibly the young of this species, were obtained at two *Nero* stations 1184 and 1287. in 1,542 and 1,606 fathoms.

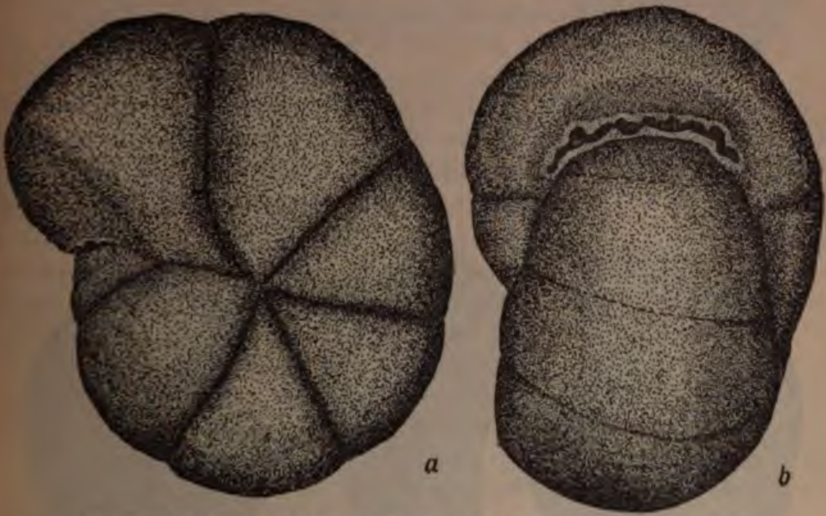


FIG. 167.—CRIBROSTOMOIDES BRADYI. × 20. *a*, SIDE VIEW; *b*, APERTURAL VIEW.

A large series of specimens like that from *Albatross* station D. 3346 shows that this is a very different species from any of the described forms to which it has usually been united. The characters in the material studied are little modified by variation.

### Genus CYCLAMMINA H. B. Brady, 1876.

*Lituola* W. B. CARPENTER (part), The Microscope, 5th ed., 1875, p. 536.—CARTER, Ann. Mag. Nat. Hist., ser. 4, vol. 19, 1877, p. 203.

*Cyclammina* H. B. BRADY (MS.) in NORMAN, Proc. Roy. Soc. London, vol. 25, 1876, p. 214; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 350. Type, *Cyclammina cancellata* H. B. BRADY.

*Description.*—Test free, composed of numerous chambers in a close-coiled nautiloid series, final revolution usually completely embracing the preceding ones except at the umbilicus; walls thick, composed of fine arenaceous material with a reddish-brown cement, exterior smooth, chambers with secondary labyrinthic structures interiorly, especially on the peripheral portion of each chamber, early chambers often becoming completely filled by this secondary growth; aperture a curved fissure at the proximal portion of the apertural face, supplemented by numerous pores on the apertural wall itself.

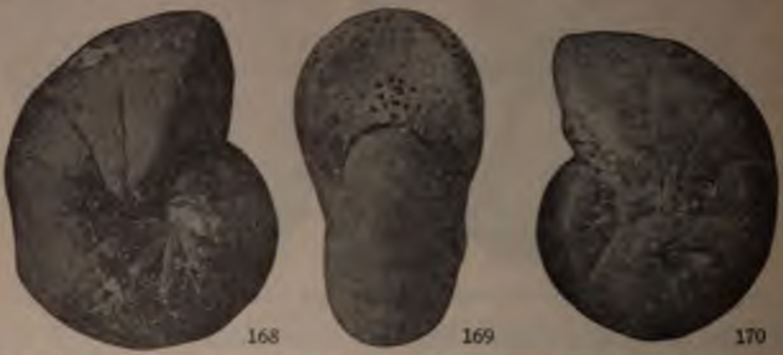
### CYCLAMMINA CANCELLATA H. B. Brady.

"Nautiloid *Lituola*" W. B. CARPENTER, The Microscope, 5th ed., 1875, p. 536, figs. 274*a*, *b*, *c* (in text).

*Cyclammina cancellata* H. B. BRADY (MS.) in NORMAN, Proc. Roy. Soc. London, vol. 25, 1876, p. 214; Quart. Journ. Micr. Sci., vol. 19, 1879, p. 62; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 351, pl. 37, figs. 8–16.—AGASSIZ, Bull. Mus. Comp. Zoöl., vol. 29, 1888, p. 164, figs. 498, 499 (in text).—J. WRIGHT, Proc. Roy. Irish Acad., vol. 1, 1891, p. 470.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 18.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 32.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 282, pl. 27, fig. 3; pl. 28, fig. 1.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 129.

*Lituola canariensis* CARTER, Ann. Mag. Nat. Hist., ser. 4, vol. 19, 1877, p. 203, pl. 13, figs. 26–29.

*Description.*—Test nautiloid, biconvex or slightly more convex at one side, umbilicated, chambers numerous, averaging about thirteen chambers in the last-formed coil, usually about three full coils in the adult test; sutures seen from the side somewhat curved anteriorly in the middle; exterior smooth and imperforate when perfect, interior of the chambers labyrinthic, the structure thus formed almost or quite filling the earlier developed chambers, peripheral edge of test rounded, with little trace of depressions at the sutures of the chambers; aperture an elongated slit near the base of the apertural face, supplemented by a series of pores occupying the central part of the apertural face, often becoming very numerous in very large specimens; color reddish-brown.



FIGS. 168–170.—CYCLAMMINA CANCELLATA. × 16. FROM PHOTOGRAPH. 169. APERTURAL VIEW. THE MEGALOSPHERIC FORM OF THE SPECIES WITH FEWER CHAMBERS IN EACH WHORL, AND ATTAINING, WHEN FULLY DEVELOPED, A SMALLER SIZE THAN THAT OF THE MICROSPHERIC FORM.

Diameter up to 6.5 mm.

*Distribution.*—The *Challenger* obtained this species at stations 237 and 244 in the North Pacific east from Japan, in 1,875 and 2,900 fathoms. Goës records it from three *Albatross* stations off the coast of Mexico, 660–995 fathoms. Bagg records it from two stations in the vicinity of the Hawaiian Islands, 495 and 865 fathoms. Flint ırds it from *Albatross* station D2860 in 876 fathoms off the st of British Columbia. I have found the species in material from *atross* station D3346 in 786 fathoms off gon, H1135 in 2, 848 fathoms just south of laska, Aleutian Islands, and twice in the inity of Japan, D4900 and D4975, in 139 712 fathoms.

s a rule, this species seems to be found in and rather deep water, following rather the faunal lines already spoken of in the oduction.

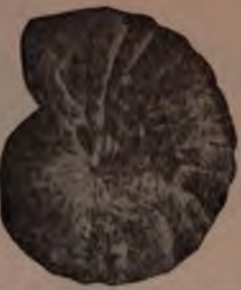


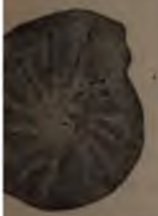
FIG. 171.—CYCLAMMINA CANCELLATA. × 8. FROM PHOTOGRAPH. THE MICROSPHERIC FORM OF THE SPECIES WITH A LARGER NUMBER OF CHAMBERS IN THE ADULT WHORLS AND ATTAINING A LARGER SIZE THAN THE MEGALOSPHERIC FORM.

he microspheric form of the species grows large size with more complicated labyhic structures and apertures. The megaloeric form is smaller and less complicated ts structure. The two forms are shown lint's plates, plate 27, fig. 3, showing the rospheric form, plate 28, fig. 1, the megaloeric. The megalospheric proloculum is considerably larger than of the microspheric form.

### CYCLAMMINA PUSILLA H. B. Brady.

*Cyclammina pusilla* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 53.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 32, pl. 6, figs. 242–244.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 18.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 32.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 282, pl. 28, fig. 2.

*escription.*—Test nautiloid, small, compressed, umbilicate, periphedge rather thin, almost keeled in some specimens, often lobud by successive chambers, composed of three coils, the last-formed enveloping the others except at the umbilicus; wall finely arenas, inclined to be porous, especially within, but not building definite labyrinthic structures; aperture a curved slit at the base of the apertural face; color reddish-brown.



172.—CYCLAMMINA LLA. × 25. FROM TOGRAPH.

Diameter 0.5–1.5 mm.

*Distribution.*—There are two *Challenger* records for this species, stations 237 and 246, at 1,875 and 2,050 fathoms, one east of Japan, the other in the middle of the North Pacific. Goës found the species at two *Albatross* stations in the eastern tropical North Pacific in 772–1,201 fathoms. Flint records this species from *Albatross* station D3080, off the t of Oregon, in 93 fathoms. I have found specimens at one station the Hawaiian Islands, *Nero* station 2032 in 1,014 fathoms; also hree *Nero* stations 1134, 1305, 1308, near the Bonin Islands in the hwestern Pacific, 2,879, 1,289, and 1,040 fathoms; and at two *tross* stations of the 1902 cruise, D4957 D4958, at 405 and fathoms, off the south coast of Japan.

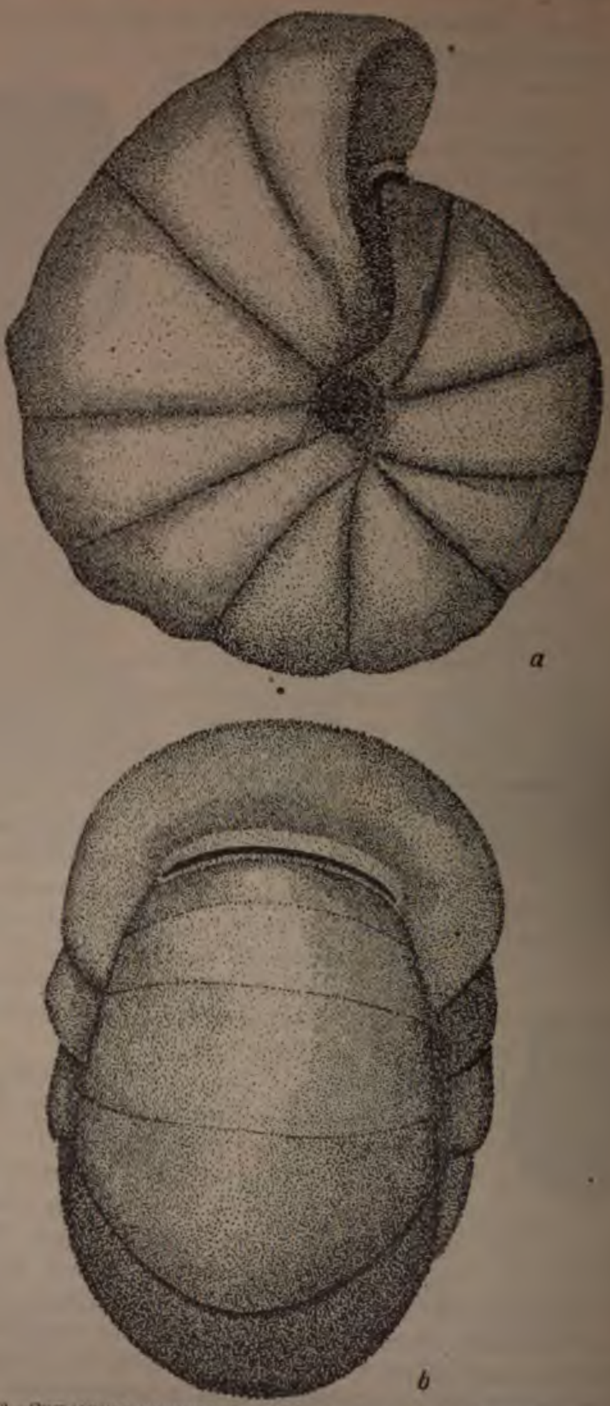


FIG. 173.—CYCLAMMINA ORBICULARIS. × 35. *a*, SIDE VIEW; *b*, APERTURAL VIEW.

As in the case of the preceding species this is limited to the deeper d colder waters, as far as the records show.

### CYCLAMMINA ORBICULARIS H. B. Brady.

*Cyclammina orbicularis* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 53; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 353, pl. 37, figs. 17–19.

*Description.*—Test nautiloid, subglobose, hardly umbilicate, perieral edge rounded, composed usually of less than two complete ils, the outer one completely hiding those previously developed, wall ely arenaceous, somewhat labyrinthic within; aperture a curved slit the base of the apertural face; color reddish-brown.

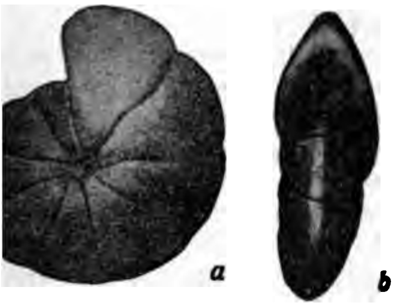
Diameter 1.5–2 mm.

*Distribution.*—There are four specimens in the Goës material from *batross* station D3419, 772 fathoms off the west coast of Mexico, at seem to belong to this species. A specimen from *Nero* station 1204, in 846 fathoms off Japan, may be the young of this species.

### CYCLAMMINA BRADYI, new species.

*Trochammina trullissata* H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 342, pl. 40, fig. 13 (not 14, 15).

*Description.*—Test free, spiral, nearly completely involute, comessed, slightly excavated at the umbilicus, last volution with six to nine chambers, smooth on the exterior, aperture crescentiform at the base of the apertural face, not included in the wall but between it and the preceding volution; apertural face occasionally with perforations in adult specimens; color yellowish or reddish brown.



. 174.—Cyclammina bradyi. × 30 (after Brady). *a*, side view; *b*, apertural view.

Diameter 1.2–1.5 mm.

*Distribution.*—Single specimens occurred at two *Nero* stations, 34 in volcanic mud, 2,879 fathoms, and station 1305 in globigerina ze, in 1,289 fathoms.

The specimen figured by Brady as *Trochammina trullissata*, rerred to above, seems to belong here. It is evidently a *Cyclammina* its characters and very different from the other specimens figured *T. trullissata*. This species is at once distinguished from the ung of *Cyclammina cancellata* and from *C. pusilla* by the smaller mber of chambers in each volution.

*Type-specimen.*—Cat. No. 8212, U.S.N.M.

## Genus LITUOTUBA Rhumbler, 1895.

*Trochammina* (part) H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 59; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 342.

*Lituotuba* Rhumbler, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 83. Type, *L. lituiformis* (H. B. Brady) = *Trochammina lituiformis* H. B. Brady.

*Description.*—Test of two distinct parts, an early close-coiled portion and a long tubular uncoiled later portion; wall arenaceous, with an excess of cement, either indistinctly or irregularly divided.

This genus seems related, on the one hand, to *Ammodiscus* through such a form as *Trochamminoides proteus* (Karrer), but shows a definite senescent character in its uncoiled form. Besides certain fossil species this genus includes the following recent species:

### LITUOTUBA LITUIFORMIS (H. B. Brady).

*Trochammina lituiformis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 59, pl. 5, fig. 16; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 342, pl. 40, figs. 4–7.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 281, pl. 26, fig. 1.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 128.

*Lituotuba lituiformis* RHUMBLER, Nachr. kön. Ges. Wiss. Göttingen, 1895, p. 84.

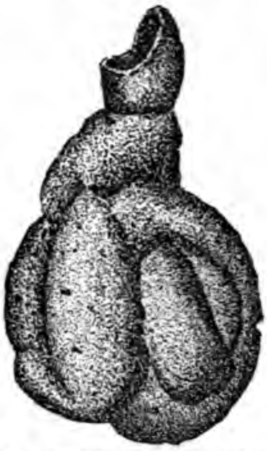


FIG. 175.—LITUOTUBA LITUIFORMIS. × 50.

*Description.*—Test composed of a close-coiled early portion and a later uncoiled portion, straight and tubular; irregularly or indistinctly divided into chambers; wall arenaceous with an excess of cement, aperture at the end of the tubular portion; color yellowish-brown.

Length up to 3.7 mm.

*Distribution.*—Bagg records a single specimen of this species from *Albatross* station D4000 in 104–213 fathoms near the Hawaiian Islands. Single specimens have oc-apertures and the other characters of the genus, but they are to be distinguished from the species included under this genus.

*Type.*—*Ammobaculites agglutinans* (d'Orbigny).

### AMMOBACULITES AGGLUTINANS (d'Orbigny).

*Spirolina agglutinans* D'ORBIGNY, Foram. Foss. Vienne, 1846, p. 137, pl. 7, figs. 10–12.

*Haplophragmium agglutinans* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 301, pl. 32, figs. 19–26.—HAEUSLER, Neues Jahrb., Beil., vol. 4, 1885, p. 13, pl. 1, figs. 22, 23; pl. 2, figs. 3, 4.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28, 1885, p. 330, pl. 13, figs. 18–20.—SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1889, p. 484, pl. 11, fig. 8.—HAEUSLER, Abh. schweiz. pal. Ges., vol. 17, 1890, p. 32, pl. 3, figs. 32, 36; pl. 4, figs. 5, 6, 18.—FORNASINI, Foram. Plioc. Pont. Savena, pl. 2, fig. 5.—CHAPMAN, Journ. Roy. Micr. Soc., 1892, p. 324, pl. 5, fig. 14.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 260, pl. 4, figs. 16, 36.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 23, pl. 5, figs. 140, 141.—CHAPMAN, Ann. Mag. Nat. Hist., vol. 16, 1895, p. 313, pl. 11, fig. 2; Proc. Zool. Soc. London, 1895, p. 16.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 32.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 357, pl. 5, fig. 1.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 126.

*Haplophragmium calcareum* FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 275, pl. 19, fig. 1 (not *H. calcareum* d'Orbigny).

*Description.*—Test free, elongate, early portion closely coiled, planospiral, of one or more volutions, each with five to seven chambers, later portion uncoiled, made up of a linear series of chambers, in adult specimens making up the larger portion of the test, wall rather coarsely arenaceous, variable in its surface, sometimes fairly smooth, sometimes rough; aperture in the early chambers at the base of the apertural face, but in the uncoiled portion in the middle of the terminal face, single, circular; color very variable from light to dark gray or brown.

Diameter of coiled portion about 1 mm., total length up to 3 mm.

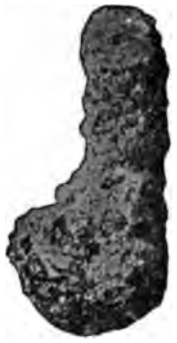


FIG. 176.—AMMOBACULITES AGGLUTINANS. × 25. FROM PHOTOGRAPH.

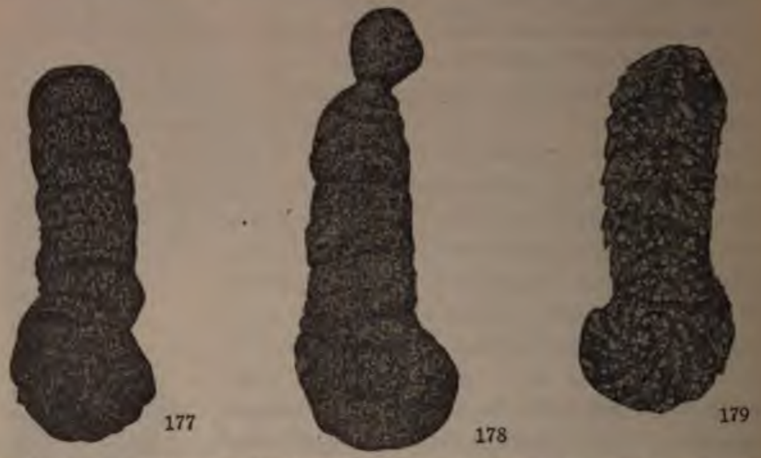
*Distribution.*—Brady records this species from five *Challenger* stations in the North Pacific, giving the depths as 7–3,125 fathoms. I am unable to find a record giving the shallowest station, but the other four range as follows: 2,050, 2,300, 2,900, and 3,125 fathoms, showing that it occurred as a rule in deep water. Bagg records the species from one station near the Hawaiian Islands, *Albatross* D4174, in 735–865 fathoms. I have found specimens of this species from six North Pacific stations. Single specimens were obtained from three *Albatross* stations near the Hawaiian Islands—H2764 in 122 fathoms, H2999 in 549 fathoms, and H3009 in 603 fathoms. It was obtained in material taken from the stomachs of Holothurians dredged at *Albatross* station D3603, 1,771 fathoms in Bering Sea, and at two *Nero* stations—1308 in 1,040 fathoms and 1410 in 1,144 fathoms—between Yokohama and Guam.

The early chambers of this species are not compressed as in the following species, but are of nearly equal diameter to those of the uncoiled portion. The species is represented by few specimens, but seems to be well distributed. There is some considerable variation in the color and texture of the material forming the wall. There is usually a rather small amount of cement visible, so that the finish of the surface of the wall depends upon the character of the material. Where the wall is smooth the chambers may easily be made out, but in the rougher specimens it is hard to distinguish their limits.

### AMMOBACULITES FOLIACEUS (H. B. Brady).

*Haplophragmium foliaceum* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 50; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 304, pl. 33, figs. 20-25.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 276, pl. 19, fig. 6.

*Description.*—"Test crosier-shaped, complanate, very thin, flat on both sides; consisting of numerous segments, the earlier ones forming two or three convolutions of a flat spire, the later ones arranged in a broad, straight, linear series. Segmentation distinct; peripheral edge slightly constricted at the sutures; septal lines arched. Aperture simple, terminal."



Figs. 177-179.—Ammobaculites foliaceus. × 40 (after Brady). 177 and 178, side views; 179, specimen mounted in Canada balsam and viewed by transmitted light.

Length $\frac{1}{20}$ inch (1.25 mm.).

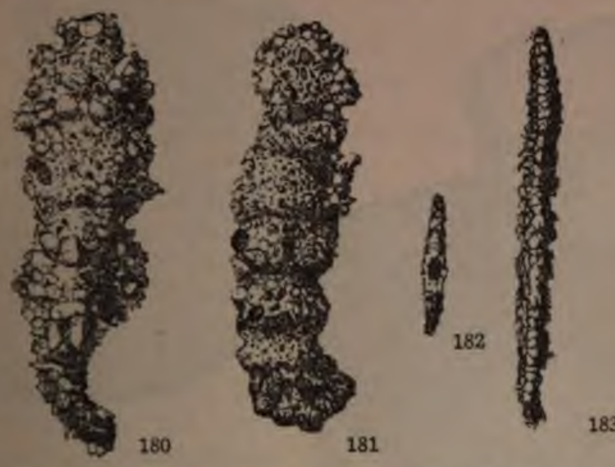
*Distribution.*—Brady records this species from a single *Challenger* station, No. 232, in 345 fathoms, on the *Hyalonema* ground, south of Japan. The specimens are recorded as "of poor dimensions and few in number."

### AMMOBACULITES TENUIMARGO (H. B. Brady).

*Haplophragmium tenuimargo* H. B. Brady, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 715; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 303, pl. 33, figs. 13-16.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 275, pl. 19, fig. 3.

*Description.*—"Test elongate, crosier-shaped, much compressed; lateral edges thin and jagged. Spiral segments few and small; those of the linear series about six in number, broad and slightly convex; septation obscure. Aperture simple, irregular in form; terminal. Texture coarse, surface extremely rough."

Length $\frac{1}{10}$ inch (2.5 mm.) or somewhat less.



Figs. 180-183.—Ammobaculites tenuimargo. × 25 (after Brady). 180, 181, from side. 182, apertural view. 183, from edge, showing thickness of test.

*Distribution.*—Brady records this species from a single *Challenger* station, No. 238, in 3,950 fathoms, east of Japan. I have seen no specimens referable to this species in the material I have examined from the North Pacific.

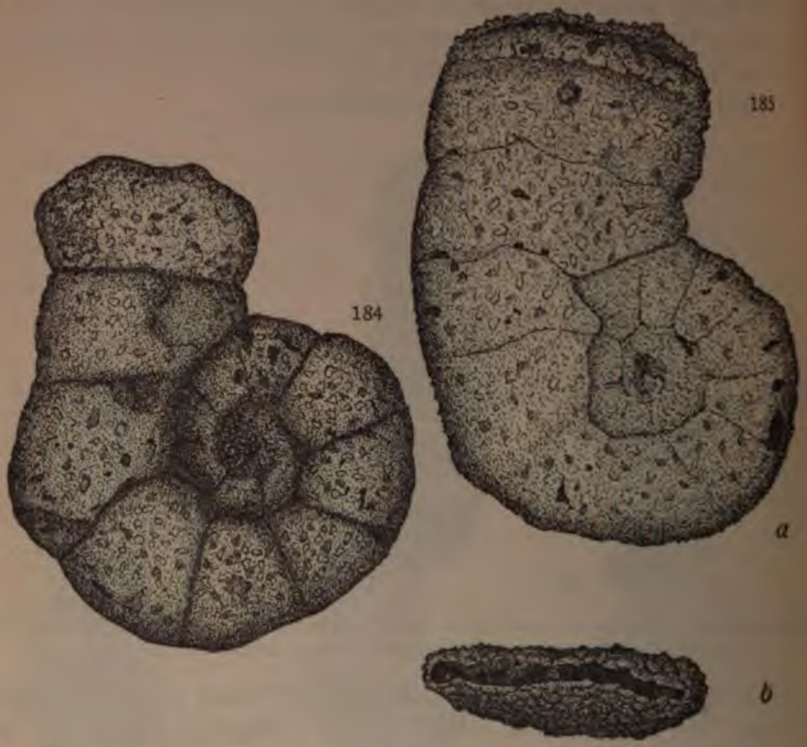
### AMMOBACULITES AMERICANUS, new species.

*Haplophragmium fontinense* H. B. Brady (not *H. fontinense* Terquem), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 305, pl. 34, figs. 1-4.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 31.

*Description.*—Test planospiral, compressed, slightly or not at all involute, the two sides alike, composed of three or four volutions with about nine chambers in the outer volution, the last formed chambers in fully grown specimens tending to form an uncoiled straight growth, wall made up of sand grains firmly cemented; aperture elongate, oval, or forming a long slit across the apertural face of the chamber; color, gray.

*Distribution.*—Specimens were found by Goës in material from *Albatross* station D3419 in 772 fathoms, off the west coast of Mexico.

This is a very different species from that described by Terquem from the Oolite of France. The original description of that species refers to a test convex on one side and concave on the other. The recent species is the same on each side and truly planospiral. The aperture varies in the recent specimens, but is usually rather elongate, and the test six times as large as the fossil species described by Terquem.



FIGS. 184-185.—AMMOBACULITES AMERICANUS. 184. × 20. 185 *a*, BROADER, MORE FLATTENED FORM; *b*, APERTURAL VIEW, × 15.

## Genus PLACOPSILINA d'Orbigny, 1850.

*Placopsilina* D'ORBIGNY, Prodr. Pal., vol. 2, 1850, p. 96.—H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 315.

*Description.*—Test attached, chambered, the early portion close-coiled, later portions uncoiling and spreading out in an irregular but in general a linear series of chambers, building no floor; last portion of the test may be entirely free, made up of an irregular series of chambers; wall arenaceous, aperture rounded, at the end of the last formed chamber.

### PLACOPSILINA CENOMANA d Orbigny.

*Placopsilina cenomana* D'ORBIGNY, Prodr. Pal., vol. 2, 1850, p. 185, no. 758.—REUSS, Denkschr. kais. Akad. Wiss. Wien, vol. 7, 1854, p. 71, pl. 28, figs. 4, 5.—BÜTSCHLI, in Bronns Klassen und Ordnungen des Thierreichs, vol. 1, 1880, p. 191, pl. 5, fig. 19.—HAEUSLER, Quart. Journ. Geol. Soc., vol. 39, 1883, p. 27, pl. 3, fig. 1; Neues Jahrb., vol. 1, 1883, p. 59, pl. 3, figs. 12–14.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 315, pl. 36, figs. 1–3.—WRIGHT, Proc. Belfast Nat. Field Club., 1884–85, App. 9, 1886, p. 320, pl. 26, figs. 3*a*, *b*.—HAEUSLER, Neues Jahrb., Beil., vol. 4, 1885, p. 8, pl. 1, figs. 24, 25.—HOWCHIN, Journ. Roy. Micr. Soc., 1888, p. 536, pl. 8, fig. 4.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc., vol. 12, 1888, p. 218, pl. 42, fig. 13.—J. WRIGHT, Proc. Roy. Irish Acad., vol. 1, 1891, p. 468.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 17.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, no. 5, 1905, p. 4, pl. 1, fig. 7.

*Lituola cenomana* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 302.—H. B. BRADY, Proc. Somerset Arch. and Nat. Hist. Soc., vol. 13, 1867, p. 105, pl. 1, fig. 1.

*Lituola (Placopsilina) cenomana* W. B. CARPENTER, PARKER, and JONES, Intr. Study Foram., 1862, p. 143, pl. 11, figs. 11–14.

*escription.*—Test attached, many chambered, the earlier portion
e coiled, more or less com-
ely involute, of one or more
tions, later portion uncoiled,
ning a linear or irregular se-
of chambers but building no
r, the body to which it is at-
ied serving as the lower
l, last formed portion in adult
imens or those which are at-
ied to small objects rising free
n the attachment and making
irregular cylindrical growth
building a wall on all sides
pt where it is in contact with
previously formed chamber;
arenaceous, variable in the
h of its surface, usually rough; aperture fairly large, rounded;
r variable, usually gray but occasionally brownish.

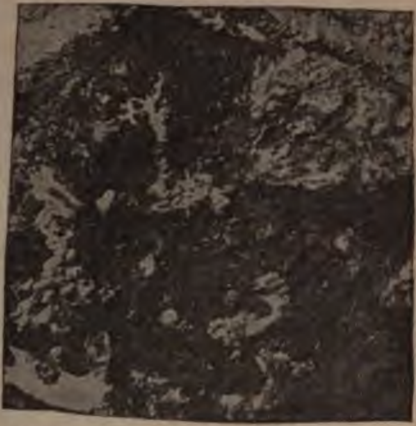


FIG. 186.—PLACOPSILINA CENOMANA. × 10. FROM PHOTOGRAPH. SPECIMEN ATTACHED TO STONE.

ngth in adults up to 5 mm., diameter 0.5–1 mm.

*istribution.*—A single specimen was found at *Albatross* station
00 in 139 fathoms, off Japan.

one looks up the various figures assigned to this species, a very
ble lot of things will be met with. I am not at all certain that
ecent material should be assigned to the cretaceous species which
bigny had, for even in recent material many specimens which
glance would be placed with this species are seen by close study
rugose species with smooth calcareous tests in the young and

belong with the Rotalidæ. If fossilized it would be difficult to distinguish such tests from truly arenaceous ones by superficial examination.

### Genus TROCHAMMINA Parker and Jones, 1860.

*Nautilus* (part) Montagu, Test. Brit., Suppl., 1808, p. 81.

*Rotalina* (part) Williamson, Recent Foram. infera of Great Britain, 1858, p. 50.

*Globigerina* (part) Williamson, Recent Foram. infera of Great Britain, 1858, p. 56.

*Trochammina* (part) Parker and Jones, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.—W. B. Carpenter, Parker, and Jones, Intr. Study Foram., 1862, p. 141.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 337.—Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 695. Type, *T. inflata* (Montagu) = *Nautilus inflatus* Montagu.

*Lituola* (part) Parker and Jones, Trans. Roy. Soc. London, vol. 155, 1865, p. 407.

*Haplophragmium* (part) Siddall and H. B. Brady, Cat. Brit. Rec. Foram., 1879, p. 4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 312.

*Ammoglobigerina* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 704.

*Description.*—Test free or sometimes adherent, spiral, trochoid, chambered; all chambers visible when viewed from above, only the chambers of the last formed volution visible from below; wall arenaceous usually with considerable cement; aperture an arched slit on the ventral side of the chamber at its contact with the preceding volution.

As here considered, *Trochammina* is restricted to those species like *T. inflata* or *T. squamata*, which have a true spiral, trochoid test with all the chambers visible only from above.

#### TROCHAMMINA SQUAMATA Jones and Parker.

olution visible from below; wall composed of sand grains of varying ze and a considerable amount of cement, surface fairly smooth; aperure a somewhat arched slit between the wall of the chamber and the djacent chamber of the previous volution on the lower side of the est; color reddish-brown.

Diameter 0.75–1.25 mm.

*Distribution.*—There are no previous published records for this species in the North Pacific. It has occurred at three *Albatross* stations, D5095 in 58 fathoms in the Gulf of Tokyo and H4881 in 316 fathoms near Blake Reef, Vincennes Strait, southern Japan. A single large specimen was obtained.

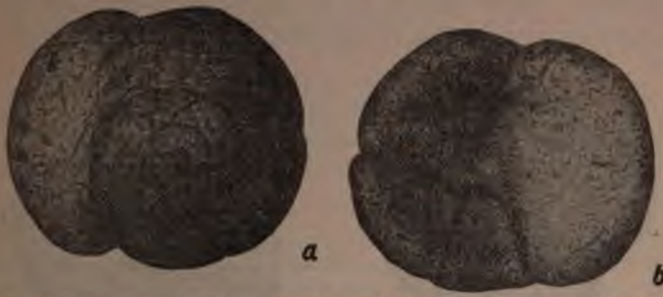


FIG. 187.—TROCHAMMINA SQUAMATA. × 50 (AFTER BRADY). *a*, FROM ABOVE; *b*, FROM BELOW.

This species is much flatter than the preceding and has fewer chambers in each volution.

### TROCHAMMINA INFLATA (Montagu).

*Nautilus inflatus* MONTAGU, Test. Brit., Suppl., 1808, p. 81, pl. 18, fig. 3.

*Rotalina inflata* WILLIAMSON, Recent Foraminifera of Great Britain, 1858, p. 50, pl. 4, figs. 93, 94.—PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 4, 1859, p. 347, fig. F.—WILLIAMSON, Pop. Sci. Rev., vol. 4, 1865, p. 174, pl. 8, fig. 8.

*Trochammina inflata* W. B. CARPENTER, PARKER, and JONES, Intr. Foram., 1862, p. 141, pl. 11, fig. 5.—H. B. BRADY, Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865, p. 95.—HAEUSLER, Ann. Mag. Nat. Hist., ser. 5, vol. 10, 1882, p. 351, pl. 15, figs. 5–7; Neues Jahrb., 1883, pl. 1, fig. 60; pl. 4, figs. 6, 7.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 338, pl. 41, figs. 4*a–c*.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28, 1885, p. 331, pl. 13, figs. 11, 12.—HAEUSLER, Abh. schweiz. pal. Ges., vol. 17, 1890, p. 65, pl. 10, figs. 25, 26.—WOODWARD and THOMAS, Geol. and Nat. Hist. Surv. Minnesota, vol. 3, 1893, p. 28, pl. D, fig. 31.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, pl. 5, figs. 10–12, 16–18.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 29, pl. 6, figs. 222–224.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 364.—FORNASINI, Mem. Real. Accad. Sci. Ist. Bologna, vol. 8, 1900, p. 367, fig. 15.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, no. 5, 1905, p. 6, pl. 1, fig. 9.

*Description.*—Test trochoid, spiral, composed of about three volutions, the last-formed one consisting of five or six inflated chambers, those of the inner volutions somewhat less inflated, all chambers ble from above, only those of the last-formed volution visible below, spire low; test umbilicate below; wall composed of fine with an excess of cement, smooth, aperture small, a short arche where the chamber meets the previous volution on the ventral and just in from the periphery; color yellowish-brown, the chambers of the spire often darker than the rest.

Diameter 0.7–1 mm.

*Distribution.*—There seem to be no published records for the oc rence of this species in the North Pacific. In the material th

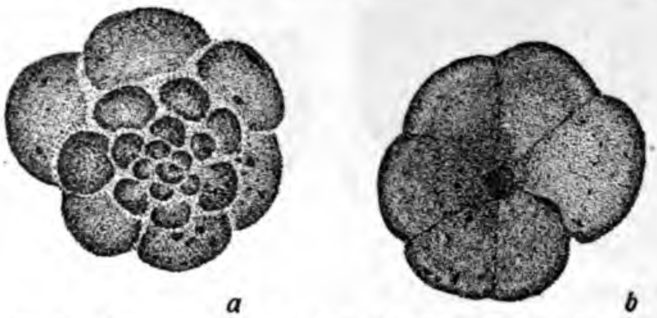


FIG. 188.—TROCHAMMINA INFLATA. × 50. *a*, FROM ABOVE; *b*, FROM BELOW.

have examined it has been seen but once, from *Nero* station 121 808 fathoms, off the coast of Japan.

### TROCHAMMINA TURBINATA (H. B. Brady).

homs near the Galapagos Islands; H1521, in 462 fathoms, off the st coast of the United States; D4998, in 66 fathoms, in the Gulf of rtary off Sakalin Island; and D4979, in 943 fathoms, Japan. Specimens were found from four *Nero* stans, 1139, 1147, 1184, and 1306, in 1,208–2,101 fathoms, tween Yokohama and Guam.

There is a considerable variation in the texture of the ecimens included here, but all have the same general aracters.

FIG. 189.—TROCHAMMINA TURBINATA. × 35. FROM PHOTOGRAPH.

Goës figured and described a variety which he named *laplophragmium turbinatum*, var. *helicoideum* Goës. pon looking up the original series labeled by Goës with his name I find among the Pacific material a very much mixed series f tests. In all, there are ten Pacific specimens, none of which at all esembles the figures given by Goës.

### TROCHAMMINA NANA (H. B. Brady).

*Haplophragmium nanum* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 50; Denkschr. kais. Akad. Wiss. Wien, vol. 43, 1881, p. 99, pl. 2, figs. 1, *a–e;* Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 406, pl. 21, fig. 1; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 311, pl. 35, figs. 6–8.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 14, 1888, p. 218, pl. 41. fig. 20.—CHAPMAN, Journ. Roy. Micr. Soc., 1892, p. 324, pl. 5, fig. 15.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 262, pl. 5, figs. 13–15.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 22, pl. 5, figs. 124–127.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 360, pl. 5, fig. 9.—RHUMBLER, Zool. Jahrb., vol. 24, 1906, p. 65, pl. 5, fig. 56.—BAGG, Proc. U. S. Nat. Mus., vol. 34, p. 127.

*Description.*—Test trochoid-spiral, spire very low, consisting of wo or more volutions, the last-formed one with six to eight chambers, omewhat flattened above but usually rotund below, very slightly r not at all umbilicate, chambers all visible from the dorsal side, nly those of the last-formed volution visible from the ventral side; alls composed of sand grains and a large amount of cement, surface irly smooth; aperture an arched slit at the periphery and ventral edge the chamber where it is in contact with the adjacent chamber of the preceding volution; color yellowish brown, the last-formed chamber often gray.

Diameter 0.21–0.75 mm.

190 191 192

IGS. 190–192.—TROCHAMMINA NANA. × 35. FROM PHOTOGRAPH.

*Distribution.*—Brady mentions but one *Challenger* station for this species, 253, in 25 fathoms, but in the volume on the "Summary of Results" two her stations are added, 246, in 2,050 fathoms, and 237, in 1,875 fathıs, the last with a question mark. Rhumbler records a single young ecimen from Laysan Island. Bagg records it from a single *Albatross* ıtion, H4694, in 865 fathoms, off the Hawaiian Islands. I found veral specimens in material from *Nero* station 992, in 1,013 fathoms, Guam.

### TROCHAMMINA GLOBIGERINIFORMIS (Parker and Jones).

*Globigerina bulloides* Williamson, Recent Foraminifera of Great Britain, 1858, p. 56, pl. 5, figs. 116–118 (not *G. bulloides* d'Orbigny 1828).

*Lituola nautiloidea*, var. *globigeriniformis* Parker and Jones, Trans. Roy. Soc. London, vol. 155, 1865, p. 407, pl. 15, figs. 46, 47.

*Lituola* (*Haplophragmium*) *globigeriniformis* Terrigi, Nuovi Lincei Atti, 1880, p. 175, pl. 1, fig. 3.

*Haplophragmium globigeriniforme* Siddall, Cat. Brit. Rec. Foram., 1879, p. 4.—W. B. Carpenter, The Microscope, 6th ed., 1881, p. 561, fig. 320 *a*, *b*.—H. B. Brady, Denkschr. kais. Akad. Wiss. Wien., vol. 43, 1881, p. 100; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 312, pl. 35, figs. 10, 11.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 329.—Haeusler, Abh. schweiz. pal. Ges., vol. 17, 1890, p. 36, pl. 4, figs. 13, 16, 17.—J. Wright, Proc. Roy. Irish Acad., vol. 1, 1891, p. 468.—Terrigi, Mem. Roy. Com. Geol. Italia, vol. 4, 1891, p. 68, pl. 1, fig. 7.—Chapman, Journ. Roy. Micr. Soc., 1892, p. 324, pl. 5, fig. 16.—Egger, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 260, pl. 5, figs. 30, 31.—Goës. Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 22, pl. 5, figs. 128–133.—Chapman, Proc. Zool. Soc. London, 1895, p. 16.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 30.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 277, pl. 21, fig. 1.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, no. 5, 1905, p. 4, pl. 1, fig. 6.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 126.

*Ammoglobigerina bulloides* Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 704.

*Description.*—Test free or adherent, spiral, trochoid, spire varying in its elevation, usually wider than high, chambers globose, all visible from above, only those of the last-formed coil visible from below; test composed of from two to four

ave found the species at numerous stations from 392-2,113 fathoms n depth in the *Albatross*, *Nero*, and *Alert* material. At *Albatross* tation D3603 it was obtained from Holothurian stomachs at a depth of 1,771 fathoms. It has occurred in largest numbers about Japan.

This species belongs in the genus *Trochammina* as here recognized. It has a regular spirally-formed trochoid test like the other species

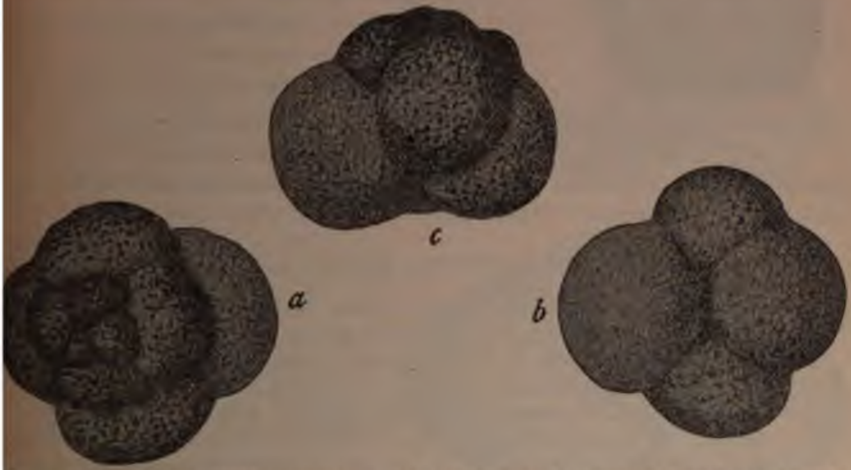


FIG. 155.—TROCHAMMINA GLOBIGERINIFORMIS. × 25 (AFTER BRADY). *a*, FROM ABOVE; *b*, FROM BELOW; *c*, FROM SIDE.

of *Trochammina* included here and differs only in the very inflated, globular character of the chambers. The elevation of the spire varies somewhat, but as a rule the test is fully as broad as high. In the texture of the wall there is some variation, the amount of cement usually being considerable.

### Genus GLOBOTEXTULARIA Eimer and Fickert, 1899.

*Haplophragmium* (part) H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 313.

*Globotextularia* EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 679.

*Description.*—Test arenaceous, the early chambers in a spire, the later ones irregular, globular, Globigerina like, containing only the following species:

#### GLOBOTEXTULARIA ANCEPS H. B. Brady.

*Haplophragmium anceps* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 313, pl. 35, figs. 12-15.—CHASTER, First Rep. Southport Soc. Nat. Sci., 1890-91 (1892), p. 57, pl. 1, fig. 2.—MILLETT, Proc. Roy. Micr. Soc., 1899, p. 361, pl. 5, fig. 10.

*Globotextularia anceps* EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 679, fig. 25 (in text).

*Description.*—Test irregular, early portion spiral with a high spire, compact, later portion with much larger globular chambers, irregular in position, usually four in regular specimens in the outer volution, wall arenaceous, surface fairly smooth; aperture near the inner end of the chamber; color brown.

Diameter 1.5 mm.

*Distribution.*—Although not recorded by Brady this species is given in the volume on the "Summary of Results" from *Challenger* station 237, 1,875 fathoms off Japan. There is a single specimen from *Albatross* station H2766 in 196 fathoms off California, which I have referred to this species.

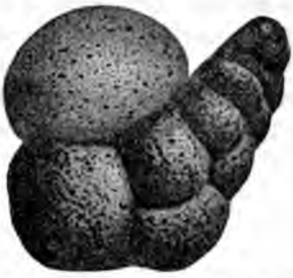


FIG. 196.—GLOBOTEXTULARIA ANCEPS. × 20 (AFTER BRADY).

### Genus AMMOCHILOSTOMA Eimer and Fickert, 1899.

*Trochammina* (part) H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 58; vol. 21, 1881, p. 52; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 344.

*Haplophragmium* (part) H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 50; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 312.

*Ammochilostoma* (part) EIMER and FICKERT, Zeitschr. wiss. Zool., vol. 65, 1899, p. 692. Type, *A. pauciloculata* (H. B. BRADY)=*Trochammina pauciloculata* H. B. BRADY.

*Description.*—Test free, early chambers spiral, later ones very involute and the last-formed volution often entirely covering the previously formed chambers and usually at an oblique angle to the

*escription.*—Test ovoid, early chambers spiral, hidden by the
chambers which are in a plane oblique to the early ones and very
lute, inflated, three or four chambers visible in an adult speci-
; wall arenaceous with an excess of cement, smooth and polished,
ture an elongate slit at
base of the chamber; color
wish or reddish brown
some of the chambers
in some specimens.
iameter 0.14–0.75 mm.

*istribution.*—From the
*llenger* work there are
recorded stations in 1,850
3,950 fathoms. Goës re-
ls the species from a sin-
*Albatross* station, 3375 in
1 fathoms, rare. I have
mined the material se-
ed by Goës and also that
rded by Bagg from the
inity of Hawaii in 689–
8 fathoms, and in both
es the material seems to
typical. The species has
urred at three *Nero* sta-
s, 170 in 1,990 fathoms
r Midway Island and at
stations 1155 and 1389
1,632 and 1,653 fathoms,
ween Yokohama and
am. It has also occurred
three *Albatross* stations,
898 and H2999, in 1,265
549 fathoms near the
waiian Islands, and D4979
43, fathoms off Japan.

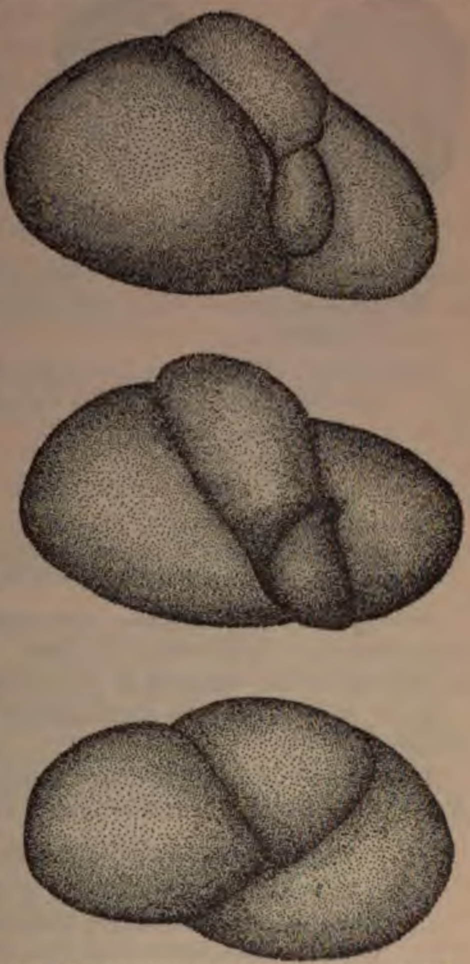


FIG. 197.—AMMOCHILOSTOMA PAUCILOCULATA. THREE VIEWS OF SAME SPECIMEN. × 100.

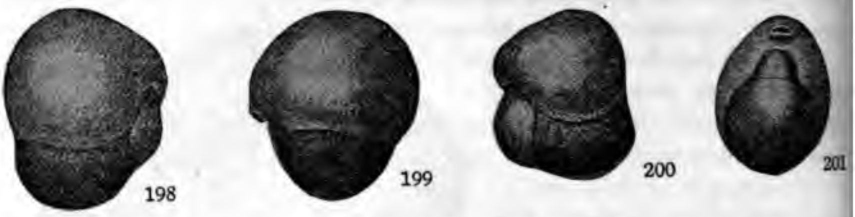
his is a very characteristic species of small size, and with little
iation. It usually occurs in but few numbers and most of the
ions for the species are in deep water.

### AMMOCHILOSTOMA GALEATA (H. B. Brady).

*Trochammina galeata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 52 Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 344, pl. 40, figs. 19–23.—EGGER, Abh. kön. bay. Akad. Wiss. München, vol. 18, 1893, p. 265, pl. 5, figs. 32–43.

*Ammochilostoma galeata* EIMER and FICKERT, Zeitschr. wiss. Zoöl., vol. 65, 1899, p. 692, fig. 39 (in text).

*Description.*—Test nearly symmetrical, subglobular, early chambers spiral, the later ones enveloping the earlier ones, the last-formed chamber in the adult forming half the area of the test, wall arenaceous with much cement, smooth; aperture a narrow slit near the base of the apertural face; color yellowish-brown.



FIGS. 198-201.—AMMOCHILOSTOMA GALEATA. × 50 (AFTER BRADY). 201, APERTURAL VIEW.

Diameter 0.5 mm.

*Distribution.*—There are two *Challenger* records for this species in the North Pacific, 224 in 1,850 fathoms and 237 in 1,875 fathoms, both in the western Pacific.

### AMMOSPHÆROIDINA, new genus.

*Haplophragmium* (part) H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 313.—HOWCHIN, Trans. Roy. Soc. South Australia, vol. 12, 1889, p. 6.—CHAPMAN, Journ. Linn. Soc., Zoöl., vol. 30, 1907, p. 24.

*Description.*—Test globose, arenaceous, early portion spiral, later chambers like *Sphæroidina* in form, embracing; aperture rounded, at one side of the chamber in the adult.

*Type of the genus.*—*Haplophragmium sphæroidiniformis* H. B.

*Distribution.*—Specimens referred to this species have been obtained at seven stations in the North Pacific; *Albatross* stations H2986 in 271 fathoms and H3012 in 2,067 fathoms, both near the Hawaiian Islands; and at several *Nero* stations near Midway Island, near Luzon and between Yokohama and Guam in 1,406–2,135 fathoms.

The structural characters of this species will not allow of its being placed in any of the genera used here in a restricted sense and it has seemed best to make a new genus for it.

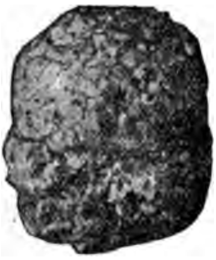


Fig. 202.—Ammosphæroidina sphæroidiniformis. × 25. From photograph.

### Subfamily 4. NEUSININÆ.

Test arenaceous with some chitin, flattened and broad, composed of many chambers, early portion coiled with the later chambers broad and spreading, sides with elongate chitinous filaments.

This subfamily containing the single species, *Neusina agassizii*, is different from the other arenaceous Foraminifera but in its general plan of structure is not unlike certain other genera.

### Genus NEUSINA Goës, 1892.

*Neusina* Goës (type, *Neusina agassizii* Goës), Bull. Mus. Comp. Zoöl., vol. 23, 1892, p. 195.

*Description.*—Test expanded, flat, made up of a series of very broad, low, flattened chambers, early ones in complete specimens apparently coiled, later ones in a broad, flat expanse of varying shape; wall arenaceous or of fine mud and sand with a chitinous network, flexible with a thread-like border of chitin; apertures numerous, along the edge of the chamber; color in fresh specimens brown.

#### NEUSINA AGASSIZII Goës.

*Neusina agassizii* Goës, Bull. Mus. Comp. Zoöl., vol. 23, 1892, p. 195, pl., figs. 1–9.

*Description.*—Similar to that of the genus, simply the one species being known.

Diameter in largest specimen, 190 mm.

*Distribution.*—Specimens of this species were found in material from a single *Albatross* station, D3399, off the northwest coast of South America in 1,740 fathoms in olive green ooze.

There has been much discussion as to whether this is really a f
raminifer or not. It has many of the characters of the group and t
main objection to placing it here is on account of its size. A sing
small specimen in the National Museum figured here shows somethi

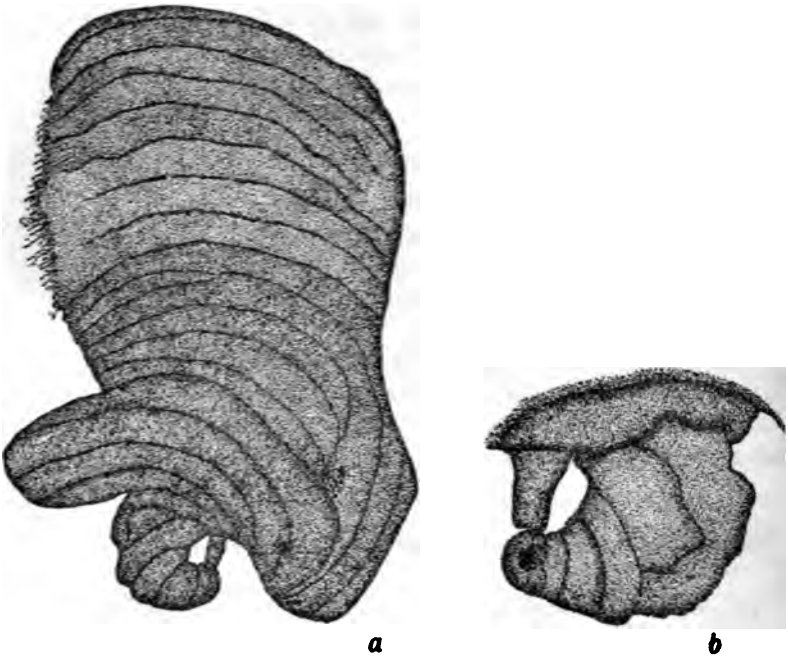


FIG. 203.—NEUSINA AGASSIZII. *a*, COMPLETE SPECIMEN, × 1½. *b*, EARLY PORTION OF SAME SPEC
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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 71

# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN

## PART II. TEXTULARIIDÆ

BY

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WASHINGTON
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# INTRODUCTION.

The present volume is the second of a series dealing with the Foraminifera of the North Pacific Ocean. It contains the Foraminifera included in the family Textulariidæ. The first part, issued in 1910, included the families Astrorhizidæ and Lituolidæ. The third part, on which work is now actively being done, will be devoted to the Lagenidæ, and further volumes will take up the remaining families of the Foraminifera as they are represented in the North Pacific.

Joseph Augustine Cushman.

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# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN.

## TEXTULARIIDÆ.

By Joseph Augustine Cushman.
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## INTRODUCTION.

This second part of the work on the North Pacific Foraminifera deals entirely with the Textulariidæ, a family following in natural sequence those families already considered in the first part. The same arrangement of data is here followed.

In addition to the material mentioned in the previous part there has been available a considerable amount dredged by U. S. S. *Tuscarora* in various parts of the North Pacific. This consists of mounted slides of Foraminifera from the various stations. It adds some species and a considerable number of records of distribution for many species.

It has been found necessary to describe several new species and to erect a few new genera, but the number of these has been kept as small as possible. The genus *Textularia*, as will be noted, contains several more or less distinct groups of species, but no attempt is here made to give these groups generic standing. The species of certain genera, such as *Bulimina* for example, are in an unsatisfactory state, and without large series of specimens it is impossible to satisfactorily delimit the various species. Figures referred to the same species by different authors are often very unlike and the synonymy thus becomes very difficult to work out satisfactorily.

Reference to the figures and descriptions of types has shown the necessity of separating our recent forms from the fossil species in a number of cases. Where this is necessary and no names are available, new names have of necessity been given to the recent species.

More strikingly perhaps than in the first part the various faunal areas are shown by the species of the Textulariidæ. Many of the species occurring in the Indo-Pacific region extend southward to the region of Torres Strait. In the North Pacific, however, these species are, as a rule, confined to the western portion from southern Japan southward. The rediscovery of some of the species described by Brady, from almost the exact locality at which they were dredged by the *Challenger*, is very interesting and tends to show the restricted distribution of certain forms.

A systematic presentation of the various groups of the family follows:

## Family 4. TEXTULARIIDÆ.

Test either arenaceous or calcareous, perforate, the chambers usually numerous, essentially biserial or triserial, or in some genera spirally arranged.

The family Textulariidæ is apparently the most primitive, after the Lituolidæ. A number of the genera are wholly or in part composed of species with arenaceous tests, which is in itself a primitive character in the group. In many species both the microspheric and megalospheric forms are known. In the microspheric form, which repeats most completely the phylogenetic characters, a coiled early development succeeding the proloculum is commonly found. This stage may be compared to the entire development of such a genus as *Haplophragmoides* in the Lituolidæ.

In the most primitive subfamily, the Spiroplectinæ, the coiled development is continued for a fairly long period, and makes up considerable portion of the test. This coiled stage also occurs i both the microspheric and megalospheric forms, showing that th subfamily is decidedly primitive, and has not as yet become case make up the greater part of the test, are biserially arranged. The stages in the development are exactly the same, but there is a difference in the proportion of each as usually occurs in the upward step in the scale, the earlier stages being shortened and the later stages coincidently shoved back and taking their place. In the megalospheric form of the species, however (fig. 17), there is a larger proloculum, followed at once by the biserially arranged chambers, the coiled stage being entirely skipped. Microspheric forms of such species of *Textularia* have been referred by many later writers to *Spiroplecta*, but in the type species of *Textularia* both of these forms occur, and if such a procedure were adhered to, the genus *Textularia* would have to be made synonymous with *Spiroplecta* and the former used as the older name, the latter being dropped. As used here, however, *Spiroplecta* includes simply those species which have a very considerable coiled stage, and in which it usually occurs in both forms, microspheric and megalospheric.

In *Textularia*, it is only very rarely, so far as observed, that a coiled stage occurs in the megalospheric form, and then in but a very few chambers. It is obvious, therefore, that the microspheric form of many species of *Textularia* has a coiled development in the young. In the more specialized species, such as *Textularia quadrilatera*, which should perhaps be removed from the genus *Textularia*, there has been observed no coiled young in either the microspheric or the megalospheric form, though the number of available specimens of each form has been large.

In this same subfamily have been included those other genera which have essentially a biserial arrangement of the chambers, such as *Bolivina* and *Pavonina*, and a biserial development followed by a uniserial, as in *Bigenerina*. In this last genus there is a coiled development in the microspheric form of at least one species.

In the subfamily Verneuilininæ, the typical arrangement of the adult chambers is triserial instead of biserial, but here again there is in the microspheric form of some species a coiled series of chambers in the young. The specimens are much more difficult to manipulate, and the coiled series may be more common than may at first appear. The expected modification, the return to the biserial condition of the previous subfamily, takes place in *Gaudryina*, in some species only in the last-formed chambers, in other species appearing by acceleration of development early in the life history, the triserial portion much reduced. In *Clavulina* there is a complete return to the uniserial condition, but with the triserial character present in the young.

The subfamily Bulimininæ, as here considered, includes the spiral forms with a loop-shaped aperture, such as *Bulimina* and *Virgulina*, the latter tending to assume a biserial arrangement. The test here is hyaline and perforate. Two new genera have been separated from the typical *Bulimina* to include species considerably different in their characters from the genus in its restricted sense.

The subfamily Cassidulininæ includes species which are like the Bulimininæ in their aperture, but which have a peculiar arrangement of the chambers. These are biserial, but are secondarily coiled in a helicoid spiral. In *Cassidulina* the species are either completely involute, or in late growth are somewhat uncoiled. In *Ehrenbergina* the uncoiling takes place early, and little of the involute character is seen.

The Textulariidæ as a whole are much more rich in ornamentation and complicated forms than are any of the preceding families. In *Bolivina* and in some species of *Bulimina*, *Ehrenbergina*, and *Virgulina* there is a considerable range of ornamentation, punctæ, limbate sutures, knobs or bosses, costæ and spines being the most common forms. On the whole, however, the ornamentation is simple and uninteresting compared with that seen in the Lagenidæ.

### Subfamily 1. SPIROPLECTINÆ.

Test either coarsely arenaceous or calcareous, or even hyaline, the early chambers following the proloculum closely coiled, the later chambers biserial, occasionally tending to become uniserial in the last developed chambers.

This subfamily includes the single genus *Spiroplecta*, which in its developmental stages connects the Textulariidæ with the Lituolidæ. Its development is primitive in that the stages are seen in both the microspheric and megalospheric forms of the species, and are of comparatively long duration.

### Genus SPIROPLECTA Ehrenberg, 1844.

*Spiroplecta* EHRENBERG (type, *S. americana* Ehrenberg), Monatsber. d. k. preuss. Akad. Wiss., Berlin, 1844, p. 75.

The characters are given above under the description of the subfamily. The name *Heterohelix* was used by Ehrenberg in 1843, but it is not clear whether it is entirely synonymous or not, and the type-species is not clearly characterized.

As noted above, many recent writers are referring to *Spiroplecta* species of *Textularia* which show a coiled arrangement of the chambers in the early development, especially in the microspheric form. Such a treatment of these species seems to be incorrect, as previously stated. Although Brady records two species of this genus from Torres Strait, neither of them has been found in the material from

### SPIROPLECTA BULBOSA, new species.

*Description.*—Test compressed, the early portion nearly circular, the later portion elongate, narrower, rectilinear; the chambers numerous, those of the early portion coiled, involute, the later biserial; wall calcareous, perforate, smooth; color white.

Length about 0.40 mm.

*Type-specimen.*—Cat. No. 8328, U.S.N.M., from *Albatross* station D4957 in 437 fathoms off the coast of Japan.

This species is small, and has a remarkably large portion of the test made up by the spirally coiled chambers. Fig. 1, *b*, shows the arrangement of the chambers in the megalospheric form, making a complete volution about the proloculum.

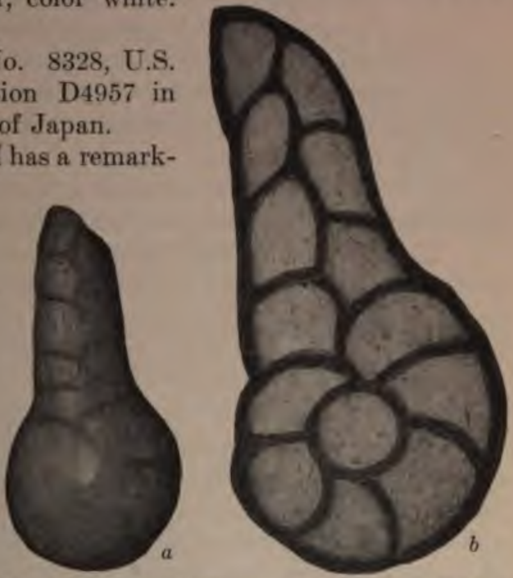


FIG. 1.—SPIROPLECTA BULBOSA. *a*, VIEW FROM EXTERIOR, SHOWING LARGE PROPORTION OF THE CIRCULAR PART OF THE TEST. × 120. *b*, OPTICAL SECTION OF THE TEST, SHOWING THE COMPLETE VOLUTION MADE BY THE COILED CHAMBERS ABOUT THE PROLOCULUM. × 200.

### Subfamily 2. TEXTULARIINÆ.

Test typically biserial, wholly or in part, the early portion in the microspheric form often with a few coiled chambers, followed by the biserial chambers; later chambers variously modified in the different genera, uniserial, broadly extended, etc.; wall either arenaceous or calcareous and hyaline, perforate; aperture single, or in a few cases, many present in a single chamber.

This subfamily includes those forms which are essentially biserial in their development, not having reached the triserial stage anywhere in their stages of development. The stages in the simpler genera are like those of *Spiroplecta*, except in duration, the biserial condition being taken on much earlier than in that genus. Variously modified forms occur as in the uniserial arrangement in *Bigenerina*, the broadly flaring later growth of *Pavonina*, and the peculiarly modified aperture in *Pleurostomella*.

### Genus TEXTULARIA DeFrance, 1824.

*Textularia* DEFRANCE (type, *T. sagittula* DeFrance) Dict. des Sci. Nat., vol. 32, 1824, p. 177; vol. 53, 1828, p. 344; Atlas Conch., pl. 13, fig. 5.

*Textilaria* EHRENBERG, Abh. d. k. preuss. Akad. Wiss., Berlin, 1839, p. 135.

*Grammostomum* EHRENBERG (part), Abh. d. k. preuss. Akad. Wiss., Berlin, 1839, p. 129.

*Plecanium* REUSS, Sitz. kön. Akad. Wiss., Wien, vol. 44, 1861 (1862), p. 383.

*Description.*—Test elongate, tapering, composed of two series of alternating chambers; wall calcareous, in the young, hyaline and perforate, occasionally so throughout the test, often with an extern coating of siliceous or calcareous sand, or in some species nearly t whole test arenaceous; aperture typically an arched slit at the inn margin of the chamber close to its line of attachment to the precedi chamber; occasionally with the aperture surrounded by a raised li or in some species with the aperture circular and terminal.

The genus *Textularia* as usually considered includes species several different sorts which might perhaps be placed in separat genera, as has been done by some authors. All have the same ge eral type of test in that the chambers, at least in the adult, a arranged biserially, each chamber alternating with the immediatel preceding and succeeding chamber of the opposite side and connectin with them, so that typically no chambers of the same series are co nected with one another except indirectly through the chambers the opposite series. In many species where a large series of spec mens can be obtained from a single dredging both the microspher and megalospheric forms of the species may be found. Here agai there is a considerable difference in the various groups. In t typical arenaceous species the microspheric form has a definitel coiled series of chambers about the small proloculum before t biserial condition is taken on. This shows its relation to *Spiroplec* and to the coiled forms of the Lituolidæ. In the megalospheric for of the same species the biserial condition is usually taken on by t two chambers immediately succeeding the large proloculum. As rule the megalospheric form is the more common, as is usually t case in other groups.

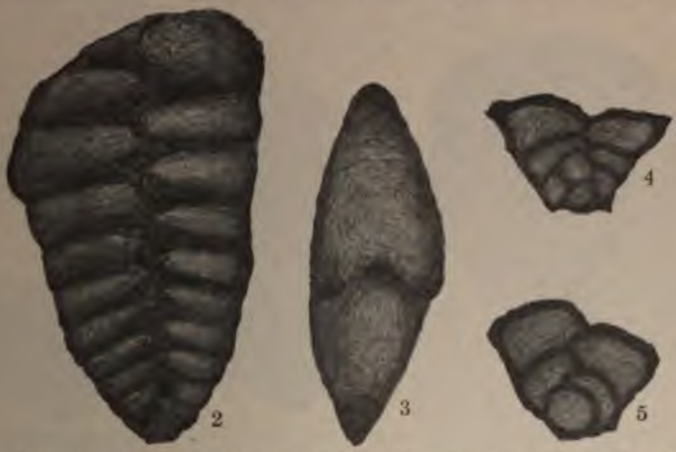
and where the aperture is circular and terminal there is no trace of an indentation.

As a whole the genus *Textularia* shows little trace of ornamentation of the test, except in the thickening of the wall at the junction of the chambers and occasionally spines at the earlier end. In a few species there are signs of raised lines of ornamentation. In one group of species there is a tendency to form proliferations at the sides of the chambers, carried to its extreme in *T. siphonifera* H. B. Brady. These are peculiar modifications of the test and occur in several species.

The largest and best-developed species of *Textularia* are from shallow water in tropical or subtropical seas, but the various species are widely distributed, both as to depth and latitude, and the geological history of the genus is apparently a long one.

### TEXTULARIA SAGITTULA DeFrance, var. ATRATA, new variety.

*Description.*—Test as a rule broader than in the typical form, the initial end broad and rounded in both the microspheric and megalospheric forms; sutures between the chambers covered by a dark material much darker than the rest of the test; test otherwise unornamented.



FIGS. 2-5.—TEXTULARIA SAGITTULA, VAR. ATRATA. 2, FRONT VIEW. × 60. 3, END VIEW OF ANOTHER SPECIMEN. × 60. 4, VIEW OF MICROSPHERIC PROLOCULUM AND SUCCEEDING CHAMBERS BY TRANSMITTED LIGHT, THE EARLY CHAMBERS FORMING A COILED SERIES ABOUT THE PROLOCULUM, THE LATER CHAMBERS ASSUMING THE BISERIAL CONDITION. × 75. 5, VIEW OF MEGALOSPHERIC PROLOCULUM AND SUCCEEDING CHAMBERS BY TRANSMITTED LIGHT, THE EARLY CHAMBERS FOLLOWING THE PROLOCULUM IMMEDIATELY ASSUMING THE BISERIAL CONDITION. × 75.

Length 1 mm., microspheric proloculum 0.04 mm., megalospheric proloculum 0.07 mm.

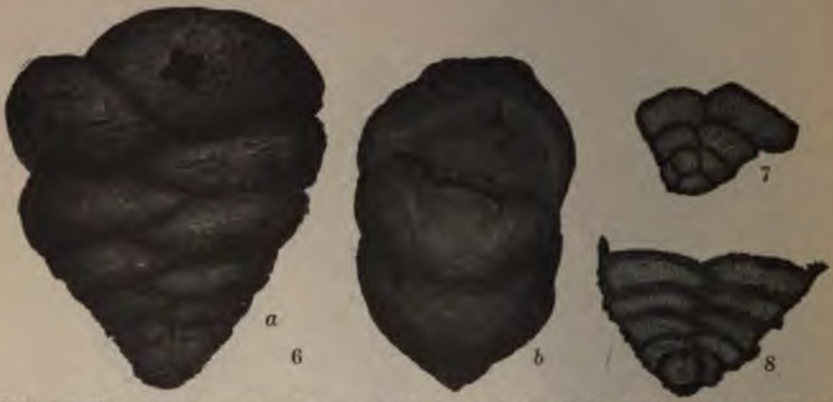
*Distribution.*—This variety occurred in some numbers at *Albatross* station D4875, in the eastern channel of the Korean Straits, in 59 fathoms. (Type, Cat. No. 8329, U.S.N.M.)

The peculiar dark condition of the material above the sutures was noted in all the specimens from this region.

### TEXTULARIA GRAMEN d'Orbigny.

*Textularia gramen* d'Orbigny, For. Foss. Vienne, 1846, p. 248, pl. 15, figs. 4, 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoölogy, vol. 9, 1884, p. 365, pl. 43, figs. 9, 10.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 332, pl. 13, figs. 13, 14.—Fornasini, Boll. Soc. Geol. Ital., vol. 6, 1887, p. 399, pl. 11, figs. 4*a*, *b*.—Terrigi, Mem. R. Acc. Lincei, ser. 4, vol. 6, 1889, p. 109, pl. 5, figs. 1, 2.—Hæsler, Abh. Schweiz. Pal. Ges., vol. 17, 1890, p. 71, pl. 11, figs. 26, 27, 37.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 470.—Fornasini, For. Plioc. Pont. Savena, 1891, pl. 2, fig. 6.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 272, pl. 6, figs. 24–26.—Chapman, Proc. Zool. Soc. London, 1895, p. 19.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 284, pl. 29, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1899, p. 563.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 7.—Chapman, Journ. Linn. Soc. (Zool.), vol. 30, 1907, p. 25, pl. 3, fig. 53.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 30.

*Description.*—Test rather short and broad, thick, subconical, increasing rapidly in diameter; chambers broad and low, the lateral borders acutely angled, the early chambers compressed, the sutures often indistinct; wall arenaceous, sometimes rough; aperture elongate, slitlike, in the indentation near the base of the inner border of the chamber.



Figs. 6-8.—Textularia gramen. 6, *a*, side view; *b*, end view. × 60. 7, microspheric proloculum and succeeding chambers viewed by transmitted light, the early chambers forming a coiled group halfway around the proloculum. × 150. 8, megalospheric proloculum and succeeding chambers, the chambers following the proloculum assuming the biserial form at once without trace of coiling. Specimen viewed by transmitted light. × 75.

Length 1 to 1.5 mm., microspheric proloculum 0.014 mm., megalospheric proloculum 0.05 mm.

*Distribution.*—This species is widely distributed. It is recorded by Bagg from seven *Albatross* stations in the vicinity of the Hawaiian Islands, in from 275–865 fathoms. From the Western Pacific I have seen specimens from Hongkong and from Gaspar Strait. One from the latter locality occurring with the typical form is shown in fig. 9, where the irregularity of the last-formed chambers gives a very different appearance to the test. Both microspheric and megalospheric specimens were found in the material from Gaspar Strait, figs. 7 and 8. In the specimen of the microspheric form but few chambers were included in the early coiled portion. The megalospheric form was, as usual, much the more common of the two.

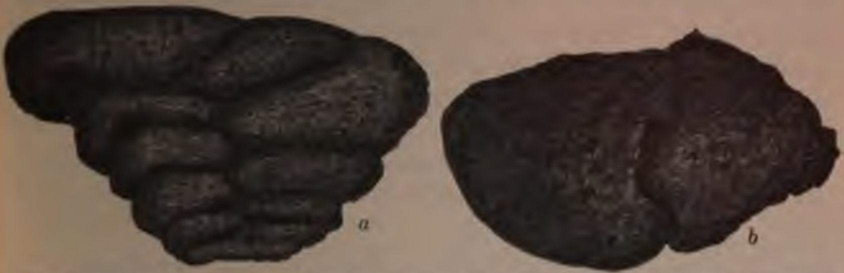


FIG. 9.—TEXTULARIA GRAMEN. *a*, SIDE VIEW, SHOWING THE PECULIARLY MODIFIED CHAMBERS IN THE LATER GROWTH; *b*, END VIEW. × 60.

### TEXTULARIA AGGLUTINANS d'Orbigny.

*Textularia agglutinans* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 136, pl. 1, figs. 17, 18, 32-34.—PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 369.—MŒBIUS, Beitr. Meeresfauna d. Insel Mauritius, 1880, p. 93, pl. 9, figs. 1-8.—H. B BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 363, pl. 43, figs. 1, 2.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 267, pl. 6, figs. 1, 2.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 1, 1894, p. 35, pl. 7, figs. 300, 301; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 41.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 562.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 7.

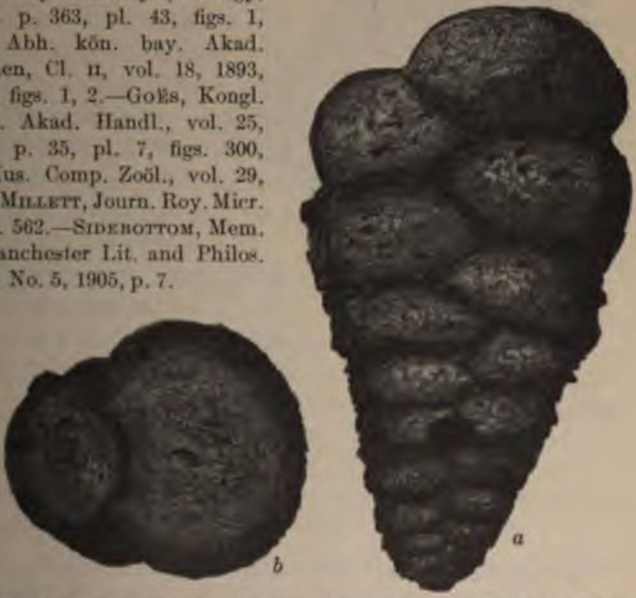


FIG. 10.—TEXTULARIA AGGLUTINANS. × 40. *a*, FRONT VIEW; *b*, END VIEW.

*Description.*—Test large and stout, somewhat elongate, the chambers high, rotund; wall coarsely arenaceous in surface view, with a calcareous base as seen in section, the early chambers somewhat compressed, in end view somewhat rounded; aperture in a well-marked depression of the inner border of the chamber, slitlike; surface roughened; last-formed chamber often more smooth.

Length 1-3 mm.

*Distribution.*—The species seems to have a wide range both in depth and latitude. Brady records it from *Challenger* station 253, in 3,125 fathoms, in the North Pacific. It is more often found in rather shallow water. Bagg records it from four *Albatross* stations near the Hawaiian Islands, in from 104–1,342 fathoms. The most typical specimens are from *Nero* station 2071, in 271 fathoms, off the Hawaiian Islands.

The various figures of specimens assigned to this species show the great variety of forms which have been grouped under this specific name.

### TEXTULARIA AGGLUTINANS d'Orbigny, var. FISTULA, new variety.

*Description.*—In general similar to the typical form, but with lateral fistulose projections on the early chambers, these in the later chambers becoming extended into a projecting peripheral border; the early chambers are somewhat compressed, the later rotund as in typical *T. agglutinans.*

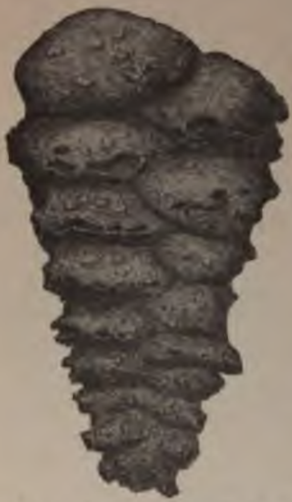


FIG. 11.—TEXTULARIA AGGLUTINANS, VAR. FISTULA. × 40.

Length 1–2 mm.

*Distribution.*—Numerous specimens of this variety were found in material from *Albatross* station H3007, in 323 fathoms, and *Nero* station 2071 (type), in 271 fathoms, both near the Hawaiian Islands; also from Blake Reef, Vincennes Strait, off southern Japan, in 248 fathoms. (Type, Cat. No. 8330, U.S.N.M.)

The specimens occur with the typical form, and are apparently a fistulose variety of it. In the form and appearance of the extended rim on the later chamber it is very different from *T. sagittula,* var. *fistulosa* H. B. Brady, which it otherwise in some ways resembles.

### TEXTULARIA HORRIDA Egger.

*Textularia horrida* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 270, pl. 6, figs. 11, 12 [*T. horroida* on explanation of plate].

*Description.*—Test broad, short, compressed, composed of a few low chambers directed backward, each extending outward into an elongated process; walls rough, made up of cemented particles of calcareous sand; aperture a curved slit in an indentation of the inner margin of the chamber.

Length 0.37–0.80 mm.

*ribution.*—Egger's specimens were from Mauritius. The speci-gured here is from the Hawaiian Islands, *Nero* station 2071, in thoms.

semilunar form of the last-formed chambers, the backward on of the outer portions of the chambers and their prolon-s serve to distinguish the s.

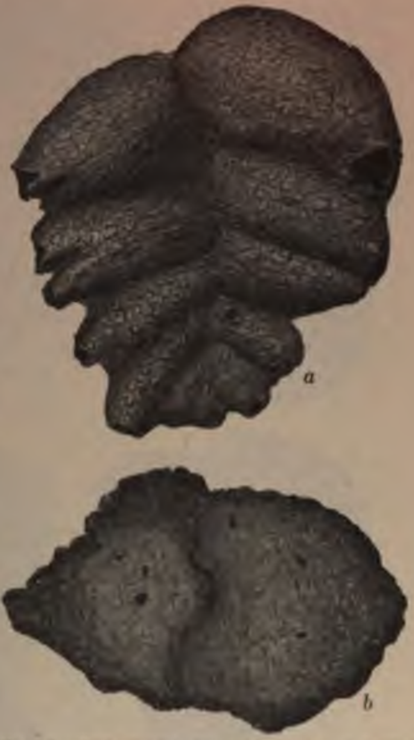
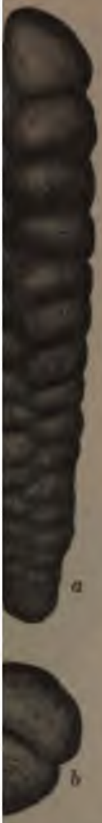


FIG. 12.—TEXTULARIA HORRIDA. × 60. *a*, FRONT VIEW; *b*, END VIEW.

**TULARIA STRICTA, new species.**



TEXTULARIA
. × 15. *a*,
IEW; *b*, END

*ription.*—Test long and narrow, composed of numerous high chambers, the early portion somewhat compressed, the later portions nearly circular in cross section, the later chambers inflated, giving a lobular outline to the test; wall arenaceous but rather smoothly finished; sutures deep; apertural end somewhat acute; aperture an elongated slit near the base of the inner border of the chamber.

Length up to 6 mm.

*Distribution.*—Specimens of this species were very common in material from *Albatross* station D4900 in the Eastern Sea off southwestern Japan, in 139 fathoms. (Type, Cat. No. 8331, U.S.N.M.)

This is one of the largest species of *Textularia* I have met with, and seems to differ from her described species in form and size, and in the form of ertural end. Some of the specimens had 40 or more ers.

### TEXTULARIA CANDEIANA d'Orbigny.

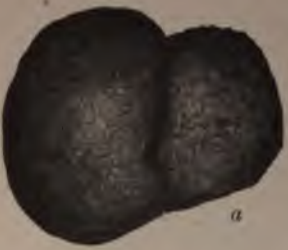
*Textularia candeiana* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 143, pl. 1, figs. 25-27.—FORNASINI, Mem. Accad. Sci. Bologna, ser. 5, vol. 10, 1902-1904, p. 137, pl., fig. 8.

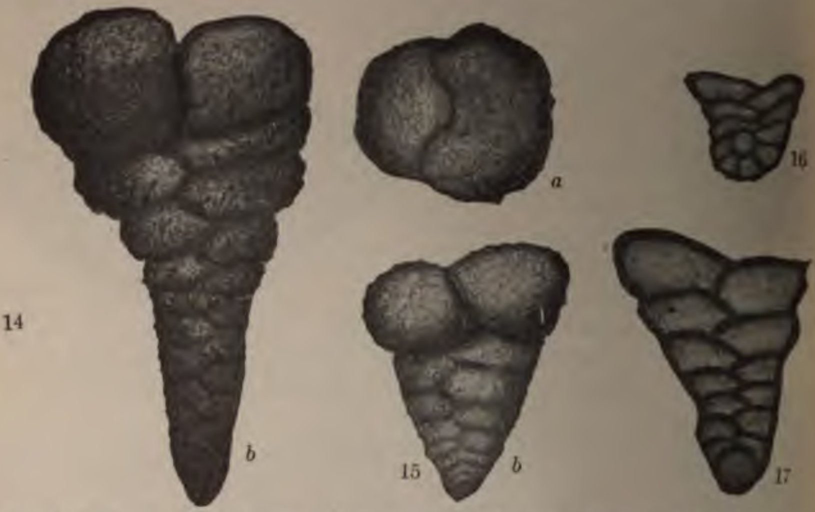
*Textularia sagittula*, var. *candeiana* MILLETT, Journ. Roy. Micr. Soc., 1899, p. 562, pl. 7, fig. 12.

*Description.*—Test elongate, club-shaped, the early portion narrow, much compressed, the edges almost carinate, slightly tapering to the round-pointed apex, the later chambers enlarging rapidly, much inflated; chambers numerous; wall rather coarsely arenaceous; aperture in a broad but shallow sinus at the base of the inner margin of the chamber; color dark gray.

Length about 1 mm.; microspheric proloculum about 0.015 mm. megalospheric proloculum about 0.050 mm.

*Distribution.*—There are no previously recorded stations for this species in the North Pacific. Fornasini refers *Textularia polita* Schwager, var. *inflata* Goës to this species. If such were really the relationship of this form, Goës's specimens would provide records for this area, but an examination of Goës's material shows it to be very different.





FIGS. 14-17.—TEXTULARIA CANDEIANA. 14, SPECIMEN FROM HAWAIIAN ISLANDS. × 60. *a*, APERTURAL VIEW; *b*, FRONT VIEW. 15, SPECIMEN FROM GASPAR STRAIT. × 60. *a*, APERTURAL VIEW; *b*, FRONT VIEW. 16, MICROSPHERIC PROLOCULUM AND EARLY COILED CHAMBERS. × 115. 17, MEGALOSPHERIC PROLOCULUM AND FOLLOWING CHAMBERS OF MEGALOSPHERIC FORM. × 115.

The species was found to be abundant in the region of the Hawaiian Islands in comparatively shallow water, at *Nero* stations 2042 and 2043, in 55 and 58 fathoms. Specimens, less elongate, were also found in material from Gaspar Strait (fig. 15).

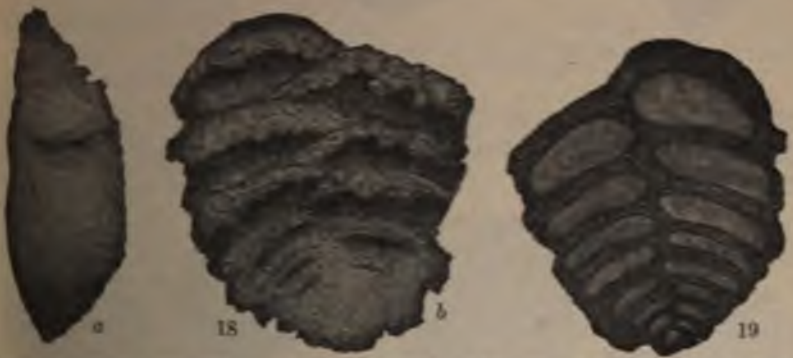
Some of the Hawaiian specimens are very much expanded at the apertural end, even more so than the figured specimen. This is especially accentuated when they are viewed laterally so that the thin edge of the early portion is seen.

Both megalospheric and microspheric forms were found in the material examined. In the microspheric form the early portion is coiled as in this form in other species. The coiling is not apparent in the megalospheric form.

### TEXTULARIA MILLETTI, new species.

*Textularia sagittula*, var. *jugosa* MILLETT, Journ. Roy. Micr. Soc., 1899, p. 561, pl. 7, fig. 8.

*Description.*—Test free, compressed, composed of numerous broad, low chambers, rapidly increasing in breadth in the earlier chambers, in end view narrow, acutely pointed at the lateral margins; wall coarsely arenaceous; distal and inner walls of chambers much thickened, forming a raised ridge, often with irregular portions extending from the proximal edge; peripheral margin thin; chambers of earlier portions often obscure in external view.



FIGS. 18-19.—TEXTULARIA MILLETTI. 18, a, END VIEW; b, FRONT VIEW. × 30. 19, OPTICAL SECTION BY TRANSMITTED LIGHT. × 45.

Length 1 mm., megalospheric proloculum 0.055 mm. (in one specimen).

*Distribution.*—Specimens referred to this species were obtained at four North Pacific stations, *Nero* stations 990 (type), in 859 fathoms, and 1464, in 891 fathoms, both near Guam; also *Nero* station 1205, in 737 fathoms, south of Yokohama, and *Albatross* station H3007, in 323 fathoms, near the Hawaiian Islands.

*Type.*—Cat. No. 8332, U.S.N.M. Apparently the recent form figured by Millett from the Malay Archipelago is the same species. The form and ornamentation of the test will distinguish this species from others of the genus.

### TEXTULARIA ABBREVIATA d'Orbigny.

*Textularia abbreviata* D'ORBIGNY, For. Foss. Vienne. 1846, p. 249, pl. 15, figs. 9–12 (7–12).—EGGER, Neues Jahrb., 1857, p. 293, pl. 12, figs. 17, 18.—FORNASINI, Boll. Soc. Geol. Ital., vol. 6, 1887, p. 399, pl. 11, figs. 1*a*, *b*, 3*a*, *b*.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 219, pl. 42, figs. 4, 5.—TERRIGI, Mem. Accad. Lincei, ser. 4, vol. 6, 1889, p. 109, pl. 5, fig. 3.—FORNASINI, Mem. Accad. Sci. Bologna, ser. 5, vol. 10, 1902–1904, p. 139, pl., fig. 10.

*Description.*—Test short and broad, somewhat compressed, the apical end bluntly and the apertural end broadly rounded; chambers few, broad and low; sutures indistinct; wall arenaceous, fairly smooth; aperture at the inner border of the chamber rather narrow and deep; color gray.

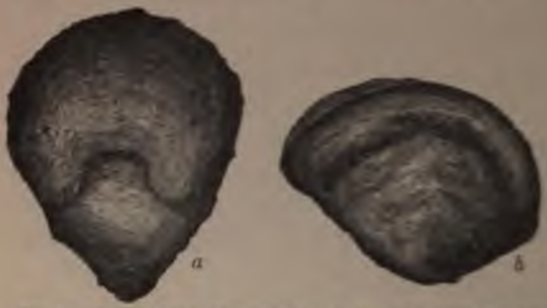


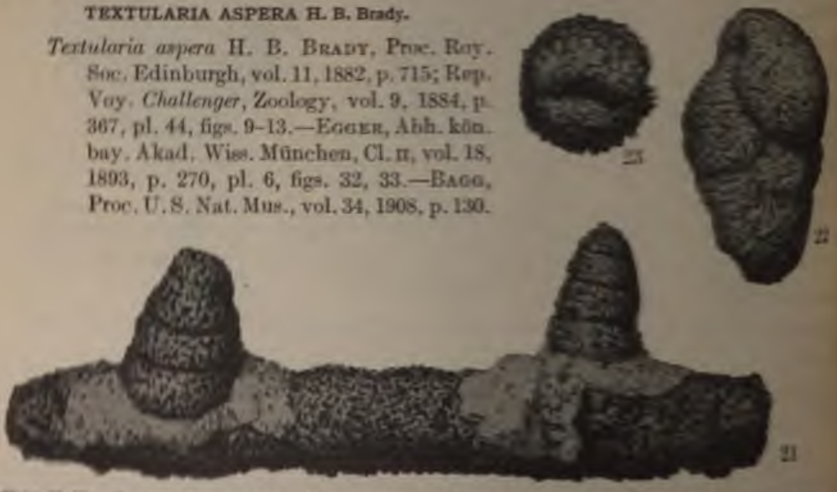
FIG. 20.—TEXTULARIA ABBREVIATA. × 60. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

Length about 0.50 mm., breadth 0.65 mm.

*Distribution.*—Apparently not previously recorded from the North Pacific. The figured specimen is from the coast of Japan, *Albatross* station D4968, in 253 fathoms.

### TEXTULARIA ASPERA H. B. Brady.

*Textularia aspera* H. B. BRADY, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 715; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 367, pl. 44, figs. 9–13.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 270, pl. 6, figs. 32, 33.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 130.



FIGS. 21–23.—TEXTULARIA ASPERA. 21, SPECIMENS GROWING ATTACHED TO A FRAGMENT OF RHABDAMMINA. × 30. 22, FRONT VIEW OF SPECIMEN DETACHED. × 25. 23, END VIEW OF ANOTHER SPECIMEN. × 25. (AFTER BRADY.)

*Description.*—Test free or adherent, rather broad, slightly tapering, somewhat compressed, in end view broadly rounded, composed of few chambers, which are inflated, with distinctly depressed sutures; chambers high; wall coarsely arenaceous, somewhat roughened; aperture a subelliptical opening at the base of the inner margin of the chamber.

Length 1.26–2.25 mm.

*Distribution.*—The only North Pacific record for this species is that given by Bagg, from the vicinity of the Hawaiian Islands, *Albatross* station D4000, in 104–213 fathoms.

Brady figures specimens growing attached to the surface of the test of *Rhabdammina*. They are surrounded at their attachment by a light-colored material, probably related to the attached condition. This habit would tend to separate the species from true *Textularia*, which is typically free.

In some respects the species is not so greatly removed from certain species of *Verneuilina*.

### TEXTULARIA GOËSII, new name.

*Textularia sagittula* DEFRANCE, var., GOËS, Köngl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, pl. 5, figs. 150–158.

*Textularia trochus* H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 366, pl. 43, fig. 17 [not 15, 16. 18, 19]; pl. 44, figs. 1-3 [not *T. trochus* d'Orbigny].

*Description.*—Test broadly triangular in front view, subcircular in end view; in front view tapering abruptly to the apex; margins convex; chambers low and broad, sutures distinct, limbate, but not deep; wall more or less coarsely arenaceous but usually rather smoothly finished; aperture linear, in a depression at the base of the inner margin of of the chamber.

Length 0.85–2.25 mm.

*Distribution.*—This species occurs in rather shallow water in various parts of the North Pacific. Bagg records it from *Albatross* station D4000, in 104–213 fathoms, in the vicinity of the Hawaiian Islands, as *T. trochus*.

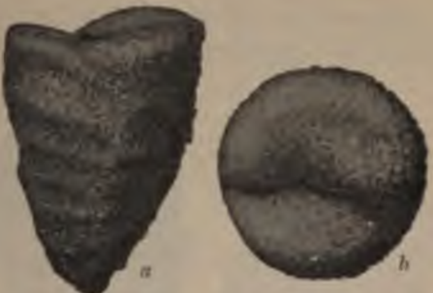


FIG. 24.—TEXTULARIA GOËSII. × 35. *a*, FRONT VIEW; *b*, APERTURAL VIEW (AFTER BRADY).

The synonymy of *Textularia trochus* illustrates well the rather interesting confusion that has arisen through the desire to unite fossil and recent species under the same name. Brady carried this union to an extreme, and the majority of later writers have been willing to follow the *Challenger* report blindly. The figure and description given by d'Orbigny of his typical *Textularia trochus* from the cretaceous

of France both call for an entirely different form of test from
recent species usually passing under that name. In d'Orbigny's sp
the test is distinctly flaring with concave sides, the sutures flush
not limbate, and the broader apertural end of the test concave.

The common recent species has a tapering test, but instead
broadly flaring later growth tends to increase in diameter less ra
as it approaches the adult condition. As a result the sides, ins
of becoming very concave are really convex, and rather strongl
The sutures as a rule are limbate and the chambers typically ov
slightly, giving a test of greatly different appearance from d'Orbi
figure.

After a study of a considerable series of foraminiferal material
various European Tertiary and other deposits, especially from Fr
I have been struck with the very considerable differences that ap
between the species of these fossil faunas and recent material.
resemblances are for the most part small, and to unite any cons
able number of these fossil species with the recent ones would r
ignoring the very real differences that exist. To unite them o
plea of great variation is not a position strengthened by a stu
large series of recent material. Therefore, it has seemed to me
to call attention to certain of the apparent discrepancies that
originated in this way and to try to correct them.

### TEXTULARIA RHOMBOIDALIS Millett.

*Textularia rhomboidalis* Millett, Journ. Roy. Micr. Soc., 1899, p. 559, pl. 7,

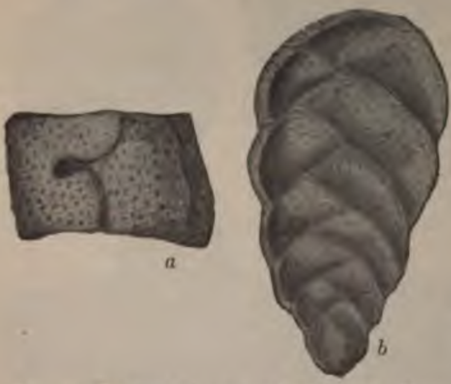


Fig. 25.—Textularia rhomboidalis. × 75.
*a*, apertural view; *b*, front view.

*Description.*—Test elongate, tapering, apical end rounded,
tural end broadly rounded, in end view quadrangular or r
boidal, the sides slightly
cave, the sutures dist
somewhat depressed, cu
wall calcareous, hy
coarsely perforate; ape
a deep rounded opening;
white.

Length 0.34–0.60 mm.

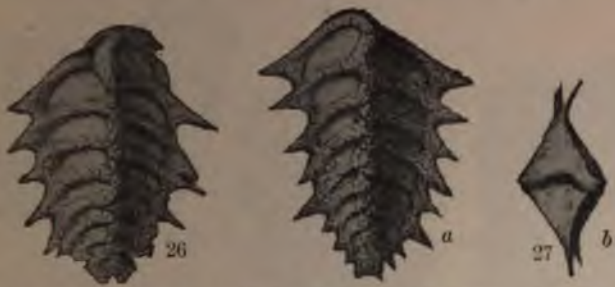
*Distribution.*—Not hit
recorded from the North
cific. One specimen
found at *Nero* station
in 55 fathoms, near the
waiian Islands. From
may be learned of the
tribution of this species, it is apparently confined to tropical
subtropical waters.

### TEXTULARIA CARINATA d'Orbigny.

*Textularia carinata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 263, No. 23; For. Foss. Vienne, 1846, p. 247, pl. 14, figs. 32–34.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 360, pl. 42, figs. 15, 16.—EGGER, Abh. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 270, pl. 6, figs. 39–41.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 284, pl. 29, fig. 1.

*Plecanium carinatum* SCHWAGER, Boll. R. Com. Geol. Ital., vol. 8, 1877, p. 26, pl., fig. 97.

*Description.*—Test somewhat elongate, fairly broad, much compressed toward the edges, sharply rhombic in end view; chambers low and broad, the sutures strongly limbate, running out into acutely pointed spines; wall coarsely arenaceous; aperture an elongate slit at the base of the inner margin of the chamber.



FIGS. 26-27.—TEXTULARIA CARINATA. × 30. 26, FRONT VIEW. 27, *a*, FRONT VIEW OF ANOTHER SPECIMEN; *b*, END VIEW (AFTER BRADY).

Length 1–1.5 mm.

*Distribution.*—The only North Pacific record for this species is that of the *Challenger* station 209, in 95 fathoms off the Philippines, where it is recorded by Brady as "tolerably abundant."

### TEXTULARIA SIPHONIFERA H. B. Brady.

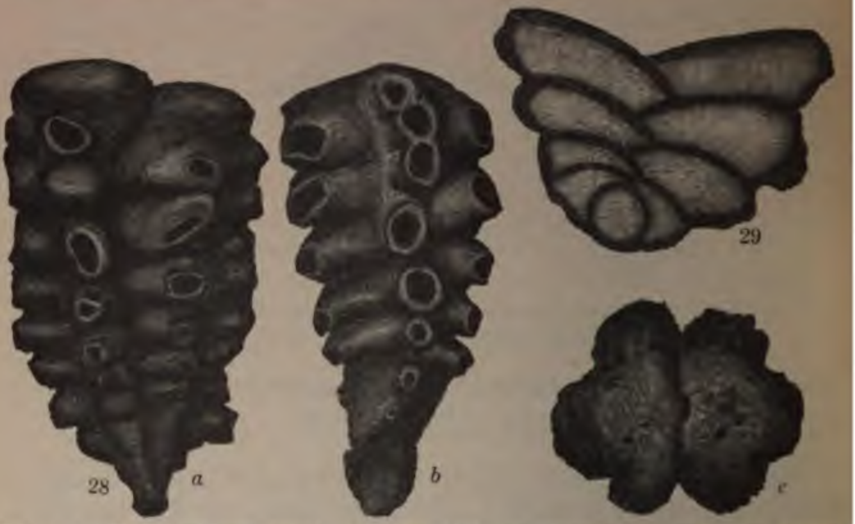
*Textularia siphonifera* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 53; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 362, pl. 42, figs. 25–29.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 130.

*Spiroplecta siphonifera* CHAPMAN, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 272, pl. 3, fig. 1.

*Description.*—Test free, elongate, subcylindrical, tapering toward the initial end, where it is often somewhat twisted and flattened; end view broadly oval with six or eight projecting portions; chambers low and broad, the earlier flattened and produced into fistulæ, the later with three or four projections, forming vertical rows with those of the chambers directly above and below; ends of the projections usually open, occasionally closed and bluntly rounded; wall arenaceous, of medium thickness; surface slightly roughened.

Length 1–2.5 mm.; megalospheric proloculum in one specimen 0.04 mm.

*Distribution.*—This species seems to be limited to the Indo-Pacific region and is best developed in shallow water in the vicinity of coral reefs. Brady records it from 40 fathoms on the coral reefs of Honolulu, Hawaiian Islands, and Bagg records it from a single *Albatross* station, H4567, in 1,307 fathoms off the same islands. This is probably a case similar to those already mentioned where currents have carried the tests of shallow water forms into the deeper water outside the reefs. I have noted the species at *Nero* station 2042 in 55 fathoms and *Albatross* station H3007 in 323 fathoms, both near the Hawaiian Islands, and *Albatross* station H4881 off Blake Reef, southern Japan, in 316 fathoms. This last station is the one already noted at which there is developed a decidedly southern coral reef fauna.



FIGS. 28-29.—TEXTULARIA SIPHONIFERA. 28, *a*, FRONT VIEW OF SPECIMEN WITH THREE PROJECTIONS ON EACH OF THE ADULT CHAMBERS; *b*, SIDE VIEW; *c*, END VIEW. × 40. 29, PROLOCULUM AND EARLY CHAMBERS BY TRANSMITTED LIGHT. × 300.

Chapman has found specimens of this species in which the megalospheric proloculum was followed by a short spiral, and refers the species to the genus *Spiroplecta*.

### TEXTULARIA INCONSPICUA H. B. Brady.

*Textularia inconspicua* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 357, pl. 42, figs. 6*a–c*.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 557, pl. 7, fig. 1.

*Description.*—"Test short, subconical, compressed laterally; distal end broadly elliptical, truncate or somewhat concave; apex rounded. Segments few, about six in each series, placed transversely; sutures flush externally. Walls thin, hyaline, perforate.

"Length $\frac{1}{100}$ inch (0.25 mm.)."

*Distribution.*—Brady recorded this species from three Pacific stations, one of which is in the North Pacific, *Challenger* station 232, in 345 fathoms on the *Hyalonema*-ground south of Japan. Millett records the species from the Malay Archipelago. I have not found the species in the material I have examined. The above description and figures are from Brady.

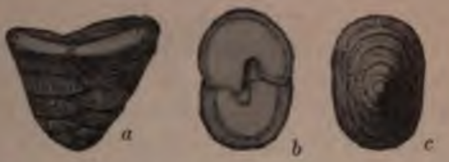


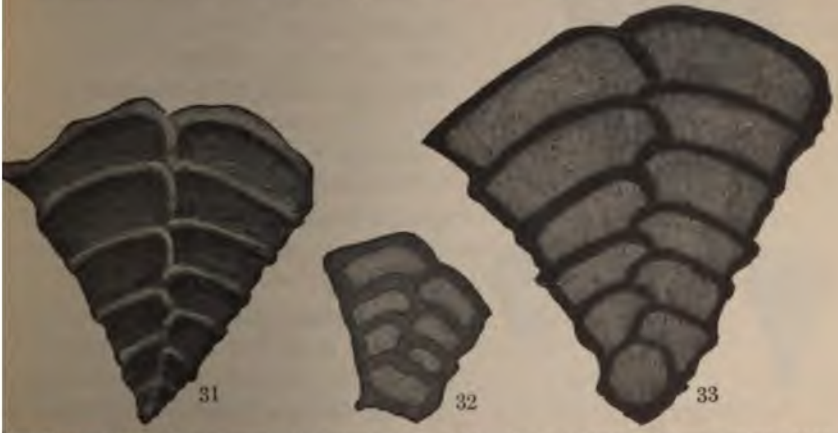
FIG. 30.—TEXTULARIA INCONSPICUA. × 70. *a*, FRONT VIEW; *b*, APERTURAL VIEW; *c*, APICAL VIEW (AFTER BRADY).

As noted by Millett this species has certain characters more like some of the Rotalidæ than like any of the other species of *Textularia*. In its aperture, also as figured both by Brady and by Millett, this same resemblance is noticed. It may be a *Discorbina*, with chambers extending half way about the circumference of the test, but a study of the apical characters and the arrangement of the early chambers should determine this.

### **TEXTULARIA FOLIUM Parker and Jones.**

*Textularia folium* PARKER and JONES, Philos. Trans. Roy. Soc. vol. 155, 1865, pp. 370, 420, pl. 18, fig. 19.—MÖBIUS, Beitr. Meeresfauna Insel Mauritius, 1880, p. 92, pl. 8, figs. 16–17.—BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 357, pl. 42, figs. 1–5.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 272, pl. 6, figs. 27, 28.—RHUMBLER, Zool. Jahrb., Abteil. Syst., vol. 24, 1906, p. 59, pl. 5, figs. 51, 52.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 130.

*Description.*—Test free, much flattened, broad, triangular in front view, in end view narrow, tapering toward the rather acute lateral margins; chambers broad and low in later development, earlier the less broad, the inner and distal margins thickened to form a raised ridge;



FIGS. 31–33.—TEXTULARIA FOLIUM. 31, FRONT VIEW. × 125. 32, EARLY CHAMBERS VIEWED BY TRANSMITTED LIGHT, SHOWING BROADLY OVAL PROLOCULUM WITH A SPINE. × 125. 33, SPECIMEN WITH SPHERICAL PROLOCULUM, BY TRANSMITTED LIGHT. × 175.

peripheral margin thin, surface smooth; wall fairly thick, clearly perforate, proloculum rounded or often somewhat quadrangular.

Length 0.18–0.54 mm., proloculum in rounded form 0.024–0.030 mm. in diameter, in quadrangular form 0.027–0.036 mm. high and 0.055–0.066 mm. in breadth.

*Distribution.*—The distribution of this species is again in the Indo-Pacific region, although it was not found by Millett in the Malay Archipelago. It has been recorded from the Australian region, from about the Fiji and Admiralty Islands, and from Mauritius. From the Hawaiian Islands it was recorded on the coral reefs of Honolulu, 40 fathoms, by Brady, and from *Albatross* station H4017, in 305 fathoms, by Bagg. Rhumbler records it from shallow water at Laysan Island. I have noted specimens from two *Nero* stations off the Hawaiian Islands, 2033 and 2071, in 249 and 271 fathoms, respectively.

This in its form and ornamentation is in many ways a rather unique species. The occurrence of double tests has been noted by several writers.

### TEXTULARIA APERTURALIS, new name.

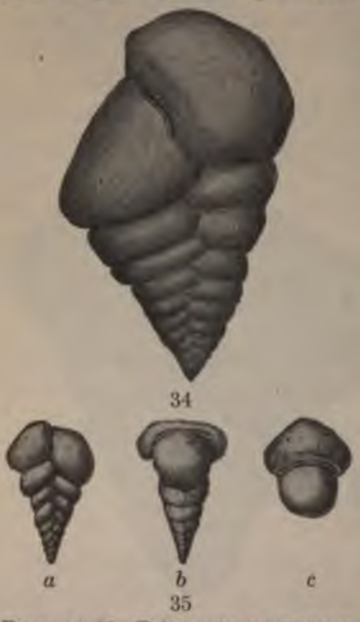
*Textularia solita* (SCHWAGER), var. *inflata* GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 42, pl. 5, figs. 1–3.

*Description.*—Test tapering, triangular in front view, the initial end acute and compressed, the later portion inflated, with high chambers; the end view broadly oval; wall composed of very fine almost amorphous material, smooth; aperture a much elongated slit slightly above the base of the inner margin of the chamber, in adult specimens divided in the median plane to form two apertures; aperture often bordered by a slightly projecting raised rim; color white.

Length 1.45 mm.

*Distribution.*—Goës described this species from *Albatross* station D3375 in 1,201 fathoms off the west coast of America.

An examination of Goës's original material does not seem to show the reason for uniting this species with *Textularia solita* (Schwager) even as a varietal form. With its peculiar inflated adult chambers and its tendency to divide the aperture, it seems to be a very distinctive species, and as *inflata* has already been used in this genus, I propose the above name for this species.



FIGS. 34-35.—TEXTULARIA APERTURALIS. 34. × 30. 35, *a*, FRONT VIEW; *b*, SIDE VIEW; *c*, END VIEW. × 20? (FIG. 35, AFTER GOËS.)

### TEXTULARIA FLINTII, new species.

*Textularia agglutinans* Flint (part), Rep. U. S. Nat. Mus., 1897 (1899), p. 284, pl. 29, fig. 4 (in part) [not *T. agglutinans* d'Orbigny].

*Textularia rugosa* Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 131 [not *T. rugosa* (Reuss)].

*Description.*—Test triangular in front view, irregularly rhombic in end view, rapidly increasing in size from the early portion, rather thick, but somewhat compressed laterally; chambers numerous, low and broad, inflated, separated by rather deep sutures; wall very finely arenaceous but smooth and shining; aperture an elongated slit slightly above the inner base of the chamber, often with a slightly raised lip.

Length about 1 mm.

*Distribution.*—Specimens referred to this species were found at *Albatross* station H2899, 1,531 fathoms, east of the Hawaiian Islands, and at *Nero* stations 1294, 1,417 fathoms, off the Bonin Islands, and 1464 (type), in 891 fathoms, near Guam; also at *Tuscarora* station 58, in 814 fathoms, near the Bonin Islands. Bagg records this species under the name of *Textularia rugosa*, as a study of his selected material shows. The figured specimens were from *Albatross* station H4568, in 1,274 fathoms, near the Hawaiian Islands.

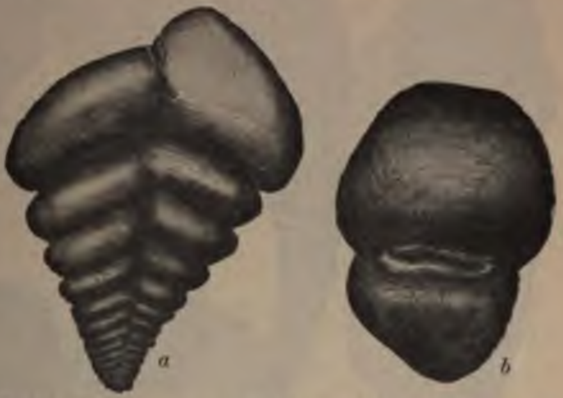


Fig. 36.—Textularia flintii. × 40. *a*, front view; *b*, apertural view.

*Type.*—Cat. No. 8333, U.S.N.M.

In the figures given by Flint this species is confused with *Textularia agglutinans*. This species differs much from typical *T. agglutinans* in the greater lateral compression, the broader, more triangular form, the low broad chambers, the rhombic or almost quadrangular outline in end view and the broad aperture with its raised border above the base of the chamber, as well as in the much smoother and polished surface.

This species may be found to be rather common if it is carefully distinguished from the others with which it has been confused.

### TEXTULARIA CRESCENTIFORMIS, new species.

*Description.*—Test elongate, slender, tapering, the initial end subacute, in side view crescentiform, gradually increasing in size from the initial end, in end view broadly rounded; chambers numerous, the earlier broad and low, becoming higher in later development and the last formed chambers higher than broad; sutures depressed and, with the somewhat tumid chambers, giving a sinuous outline to the test; wall arenaceous but of fine material and smoothly finished; aperture narrow, slightly above the base of the inner border of the chamber.

Length about 1 mm.

*Distribution.*—This species was found near the Hawaiian Islands at *Nero* station 2034, in 175 fathoms.

*Type.*—Cat. No. 8334, U.S.N.M.

This species in some respects resembles *Bolivina* but in most characters is a *Textularia*. The curvature of the test in side view is marked.

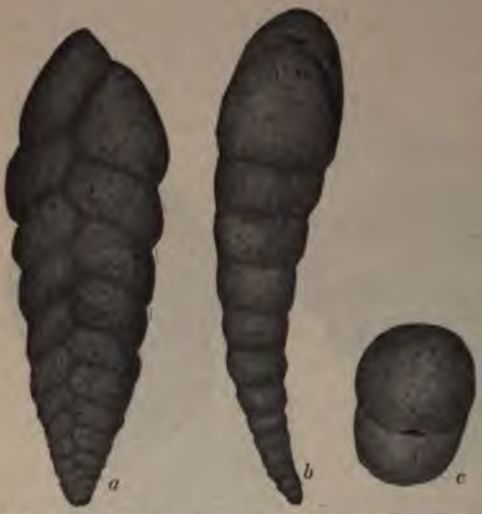


FIG. 37.—TEXTULARIA CRESCENTIFORMIS. × 75. *a*, FRONT VIEW; *b*, SIDE VIEW, SHOWING THE DISTINCT CURVATURE OF THE TEST; *c*, APERTURAL VIEW.

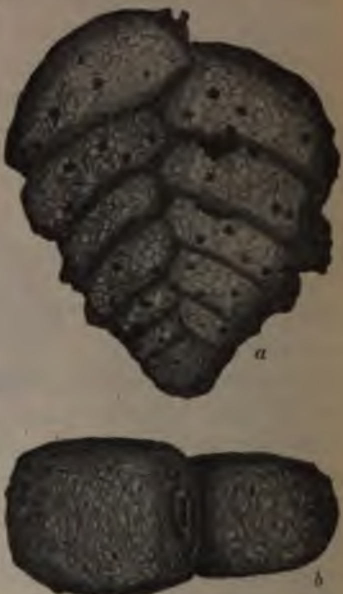


FIG. 38.—TEXTULARIA CONCAVA. × 60. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

### TEXTULARIA CONCAVA (Karrer).

*Plecanium concavum* KARRER, Sitz. kais. Akad. Wiss., Wien, vol. 58, 1868, p. 129, pl. 1, fig. 3.

*Textularia concava* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 360, pl. 42, figs. 11, 12 [not pl. 43, fig. 11].—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 471.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 271, pl. 6, figs, 3, 4 [?].—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 42.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 283, pl. 28, fig. 5.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 559, pl. 7, fig. 5.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 7, pl. 1, fig. 11.

*Description.*—Test tapering, becoming broad in the adult, compressed, broad faces often distinctly concave; chambers low and broad, squarely truncated laterally; wall arenaceous; aperture a narrowly elliptical opening, surrounded by a raised lip, somewhat above the base of the inner wall of the chamber.

Length 0.5–1.0 mm.

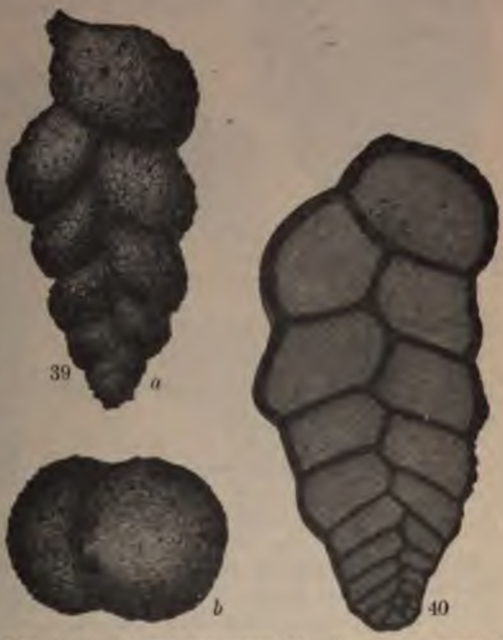
*Distribution.*—This species is apparently not common in the North Pacific. It has been noted occasionally in the material from about the Hawaiian Islands.

### TEXTULARIA CATENATA, new species.

*Description.*—Test elongate, rounded in end view, composed of inflated chambers separated by rather deep sutures, making the outline of the test sinuate; wall somewhat coarsely arenaceous; aperture in the early chambers slit-like at the ventral border of the inner margin, in later chambers gradually moving away from the margin and in the last-formed chamber subterminal and rounded.

Length about 1 mm.; microspheric proloculum 0.022 mm.

*Distribution.*—This species was obtained from two *Nero* stations in the western North Pacific, station 1160 (type), in 1,907 fathoms and station 1320, in 2,048 fathoms. These stations are between Yokohama and Guam, one occupied on the northern voyage, the other on the return. They are but a few miles apart and the difference in depth is unimportant.



FIGS. 39-40.—TEXTULARIA CATENATA. 39, *a*, FRONT VIEW; *b*, APERTURAL VIEW. × 60. 40, ANOTHER SPECIMEN, MICROSPHERIC, BY TRANSMITTED LIGHT, SHOWING THE MICROSPHERIC PROLOCULUM FOLLOWED BY FOUR CHAMBERS IN A COIL BEFORE THE BISERIAL CONDITION IS TAKEN ON. × 120.

*Type.*—Cat. No. 8335, U.S.N.M.

The microspheric form of the species which is here figured has several small chambers in a coil about the proloculum. Then follows a series of broad low chambers, arranged biserially (fig. 40.)

Such species as this, with the terminal rounded aperture, have clearly essential characters different from the typical species of *Textularia* with the elongated aperture at the base of the inner border, yet these forms here described are evidently directly related to typical *Textularia* as is shown in their early development.

This species has a slight resemblance in its last chambers t
*dryina siphonella* Reuss, but is not a *Gaudryina*, having the
arrangement developed directly after the coiled series of ch
in the young.

### TEXTULARIA CRASSISEPTA, new species.

*Description.*—Test broad, much compressed, in end view
rangular, composed of rather few chambers, the earlier l
broad, the later shorter and comparativel
walls coarsely arenaceous; borders of ch
much thickened and appearing as rais
tions with depressed areas between; a
becoming t
some distanc
the inner bo
the chamber
adult.

Length 0.
mm.

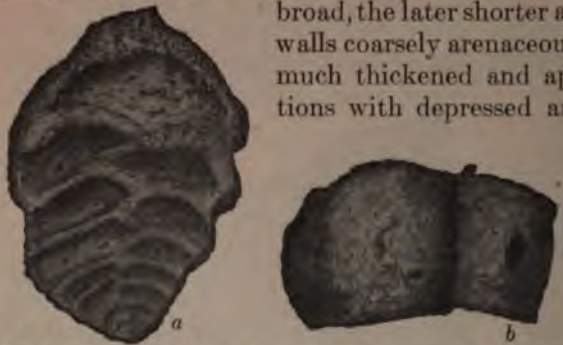


FIG. 41.—TEXTULARIA CRASSISEPTA. × 60. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

*Distribution*
species was fo
*Albatross* station H3007, in 323 fathoms, near the Hawaiian I

*Type.*—Cat. No. 8336, U.S.N.M.

In some respects this species suggests *Textularia concava*,
readily distinguishable.

### TEXTULARIA QUADRILATERA Schwager.

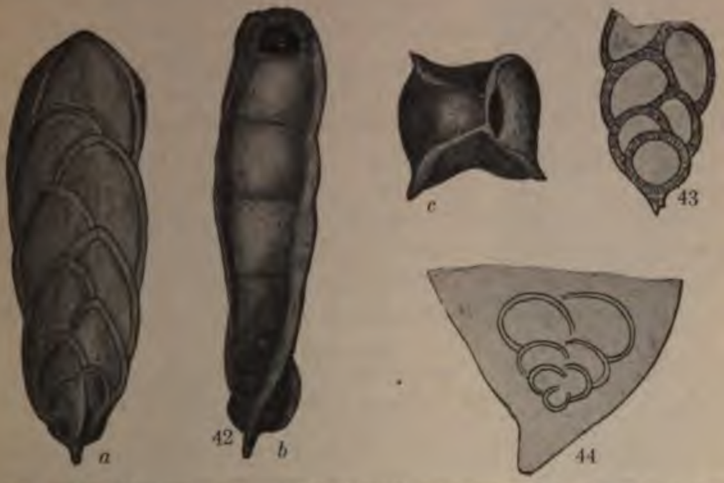
*Textularia quadrilatera* SCHWAGER, *Novara* Exped., Geol. Theil, vol. 2,
253, pl. 7, fig. 10.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology
1884, p. 358, pl. 42, figs. 8-12.—FLINT, Rep. U. S. Nat. Mus., 189
p. 283, pl. 28, fig. 3.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 5
fig. 3.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 131.

*Bolivina quadrilatera* WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 189

*Description.*—Test elongated, slender, very slightly taper
end view quadrilateral, the angles usually carinate; chambe
and narrow, running back obliquely on the outer border, comp
the initial end of the test often with a stout spine, occasional
several small spines or smooth and broadly rounded, th
chambers sometimes with one or more longitudinal raised
for a short distance; wall hyaline, distinctly perforate; aper
one side near the distal end of the chamber, sometimes ob
elongate, but somewhat variable.

Length up to 1.2 mm., megalospheric proloculum 0.07
mm., microspheric proloculum 0.012-0.023 mm.

*Distribution.*—The distribution of this species is very interesting. According to the *Challenger* report, it was found once in the South Atlantic and at a number of stations in the South Pacific, in from 410 to 1,350 fathoms. Flint records it from near Colon, Canal Zone, in 896 fathoms. Bagg records it from two stations near the Hawaiian Islands, station H4430, in 1,544 fathoms, and station H4568, in 1,274 fathoms. In the material I have examined it has occurred very frequently in the western North Pacific. Off the coast of Japan it was often noted in the *Albatross* material, and also in the *Nero* material from the line of soundings between Yokohama and Guam. The depths range from 191 to 891 fathoms, with a single record from 1,599 fathoms.



FIGS. 42-44.—TEXTULARIA QUADRILATERA. 42, MEGALOSPHERIC FORM; *a*, FRONT VIEW; *b*, SIDE VIEW; *c*, APERTURAL VIEW. × 60. 43, OPTICAL SECTION THROUGH THE EARLY CHAMBERS OF A MEGALOSPHERIC SPECIMEN. × 60. 44, OPTICAL SECTION THROUGH THE EARLY CHAMBERS OF A MICROSPHERIC SPECIMEN. × 275.

Both microspheric and megalospheric forms occurred in the material examined. In the microspheric form, which is not common, the proloculum is very small and the initial end of the test very tapering, the full width of the test not being attained until near its completion. The microspheric proloculum in the specimens examined varied from 0.012 to 0.023 mm. in diameter. In the megalospheric form the proloculum is much larger, often of nearly as great a diameter as that of the completed test and greater than the thickness of any other portion of the test. This form is therefore usually less tapering, with nearly parallel sides. The megalospheric proloculum varied from 0.076 to 0.115 mm. In the record kept the ratio of frequency of the megalospheric to the microspheric form was about 6 to 1.

This species, as has been suggested by various authors like *Bolivina* in some respects than like the other species of *T* I have left it in the latter genus for the present, not with doubts.

Both forms of the species are, so far as has been noted, coiled series of chambers in the early development of th character which seems cha of the microspheric form in cies of *Textularia*. This wou place the species as a highly s one which in its acceleration opment had skipped this st ontogeny even in the mi form.

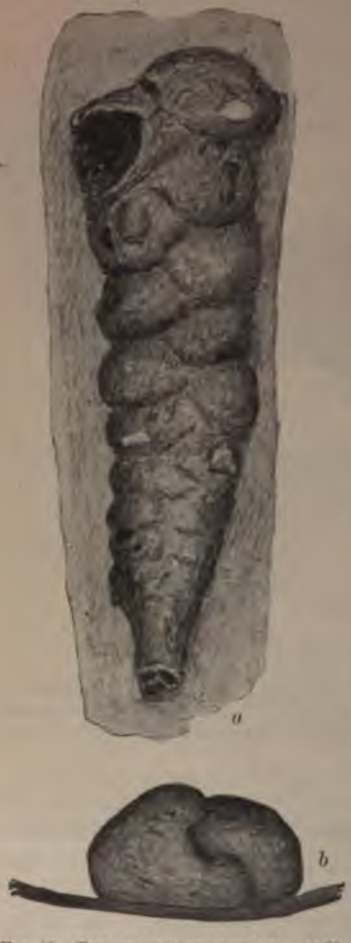


FIG. 45.—TEXTULARIOIDES INFLATA. × 30. *a*, FRONT VIEW; *b*, END VIEW.

## TEXTULARIOIDES, nev

*Description.*—Test attache ing of a *Textularia*-like series bers, arranged in two series, t bers of one series alternating of the other; wall arenaceous; an elongated slit in a depr the base of the inner marg chamber.

*Type of the genus.*—*Text inflata*, new species.

This genus is closely relat *tularia*, being mainly disting the attached habit and the c changes in the structure of t

### TEXTULARIOIDES INFLATA, nev

*Description.*—Test attach gate, slender, biserial, com alternating series of chamb slightly wider than high; sut distinct; chambers inflated sinuous; wall coarsely ar aperture an elongated slit in a depression at the ventral the inner margin of the chamber.

Length 2.5 mm.

*Distribution.*—This species was found attached to a fra shell dredged by the *Albatross* at station D4900, in 139 fa the coast of Japan.

*Type.*—Cat. No. 8337, U.S.N.M.

Apparently this specimen is megalospheric, as the chambers immediately succeeding the proloculum are arranged biserially, with no trace of a coiled series of chambers. The species is a large and striking one.

### Genus BIGENERINA d'Orbigny, 1826.

*Bigenerina* D'ORBIGNY (type, *B. nodosaria* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 261.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 368.

*Description.*—Test free, elongate, composed of a series of biserial chambers in the early portion, followed by several chambers uniserially arranged; aperture typically an oval or rounded opening near the middle of the terminal face; walls fairly thick, arenaceous, usually fairly coarse, but sometimes of fine material and smooth.

The specimen figured originally by d'Orbigny is rather characteristic. It has twelve biserially arranged chambers followed by a uniserial series of four chambers. In his sectional figure d'Orbigny shows the apertures of the early portion as truly textularian on the border of the inner margin of the apertural face, between it and the preceding chamber, while in the uniserial chambers it becomes a central opening in the middle of the terminal face of the chamber.

Later authors have included in this genus a great variety of species with characters not in accord with those established by d'Orbigny. Brady, in his synonymy, gives a long list of genera which he places wholly or in part in this genus.

As shown in *B. arenacea* Bagg, there are apparently both megalospheric and microspheric forms present. In the microspheric form the early chambers following the proloculum are coiled, as in the microspheric form of various species of *Textularia*, and like both forms in *Spiroplecta*. Later chambers are biserially arranged, as in *Textularia*, and those of the last formed group are arranged uniserially, giving the generic character. In the megalospheric form the coiled chambers may be wanting. As in other types, the microspheric form of the species attains the larger size.

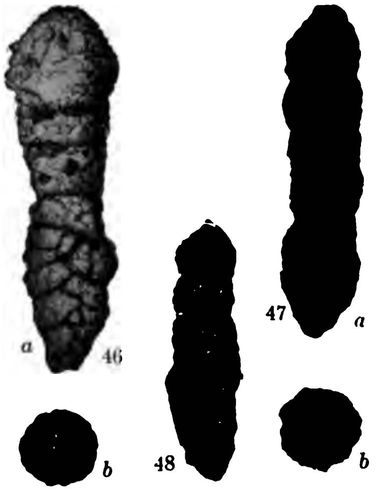
#### BIGENERINA NODOSARIA d'Orbigny.

*Bigenerina nodosaria* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 261, pl. 11, figs. 9-11; Modèles, 1826, No. 57.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 28, pl. 2, fig. 62.—TERRIGI, Atti. Acc. Pont. Nuovi Lincei, vol. 33, 1880, p. 192, pl. 2, fig. 28.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 369, pl. 44, figs. 14–18.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 471.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 37, pl. 7, figs. 313–315 [316–323?]; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 44.—FLINT, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 286, pl. 31, fig. 4.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 564, pl. 7, fig. 13.

*Textularia agglutinans*, var. *nodosaria* PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 371, pl. 15, fig. 25; pl. 17, fig. 80.

*Clavulina elegans* KARRER, *Novara* Exped., Geol. Theil, vol. 1, 1864, p. 80, pl. 16, fig. 11.

*Description.*—Test elongate, the early portion composed of a biserial group of chambers, considerably flattened and with the sutures clearly marked externally; chambers progressively broader; later portion composed of a uniserial group of chambers, rounded, usually less in width than the biserial portion; wall usually coarsely arenaceous, sometimes of fine material and nearly smooth; aperture in the early portion as in *Textularia*, an elongate slit between the base of the inner margin of the chamber and the adjacent wall of the preceding chamber, in the later portion rounded and in the middle of the terminal face of the chamber; color white or light gray.



FIGS. 46–48.—BIGENERINA NODOSARIA. × 35. 46, *a*, FRONT VIEW; *b*, END VIEW. 47, *a*, FRONT VIEW; *b*, END VIEW. 48, LONGITUDINAL SECTION OF THE TEST (AFTER BRADY).

Length about 1 mm.

*Distribution.*—In the North Pacific this species is recorded by Brady in shallow water from three localities: China Sea; Hongkong Harbor, 7–10 fathoms; Inland Sea, Japan, 15 fathoms.

Outside the North Pacific it is widely distributed.

FIG. 49.—BIGENERINA DIGITATA. × 30. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

**BIGENERINA DIGITATA d'Orbigny.**

*Bigenerina digitata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 262; Modèles, 1826, No. 58.—H. B. BRADY, Trans. Linn. Soc., London, vol. 24, 1864, p. 468, pl. 48, fig. 8; Nat. Hist. Trans. Northumberland, vol. 1, 1865–67 (1867), p. 102, pl. 12, fig. 7.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 28, pl. 2, fig. 61.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 370, pl. 44, figs. 19–24.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 471.

*Textularia agglutinans*, var. *digitata* PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 371, pl. 17, fig. 81.

*Description.*—Test fusiform or cylindrical, elongate, rounded in cross section, the early portion consisting of a number of chambers arranged biserially, but circular in cross section; sutures somewhat indistinct; apex bluntly rounded; later portion consisting of a number of chambers arranged uniserially; division between the two portions not marked [redacted] a nearly smooth surface; aperture rounded, small, usually in the middle of the apertural face.

Length 1–1.6 mm.

*Distribution.*—Although this species has not heretofore been recorded from the Pacific, specimens from *Albatross* station D4949, in 110 fathoms on the coast of Japan, seem to belong to it. It occurs with numerous other species of the colder water area, which are similar to or identical with those of the northern Atlantic.

This species at first sight might be taken for a *Clavulina,* but the early chambers are biserial instead of triserial, as is the case in the early development of *Clavulina.* The species differs from the preceding in the early portion, which is here rounded, in *B. nodosaria,* being much flattened, and in the union between the biserial and uniserial portions, which are clearly distinguished in *B. nodosaria* by the difference in diameter of the test at that point, while in *B. digitata* the point of union is hardly distinguishable, except by the sutures.

### BIGENERINA ARENACEA Bagg.

*Bigenerina arenacea* Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 132, pl. 5, figs. 4–6.

*Description.*—Test flattened, fairly large, composed of a series of chambers arranged biserially, followed by a later portion made up of broad, somewhat arched chambers arranged uniserially, both portions much compressed; in cross section elongate oval; sides well rounded, not at all carinate; wall arenaceous, varying in coarseness, smoothly finished; aperture in the later portion an oval opening in the middle of the apertural face.

Length up to 3 mm.

*Distribution.*—This species was described by Doctor Bagg from several *Albatross* stations in the vicinity of the Hawaiian Islands. I have examined the type and other specimens returned to the National Museum, and have found specimens from two other *Albatross* stations, station H2999, in 549 fathoms, and station H2986, in 271 fathoms. A specimen from *Nero* station 990, in 859 fathoms, off Guam, apparently belongs to this species. It is somewhat more smooth and of finer material than usual, but this is probably due to local conditions of the bottom.

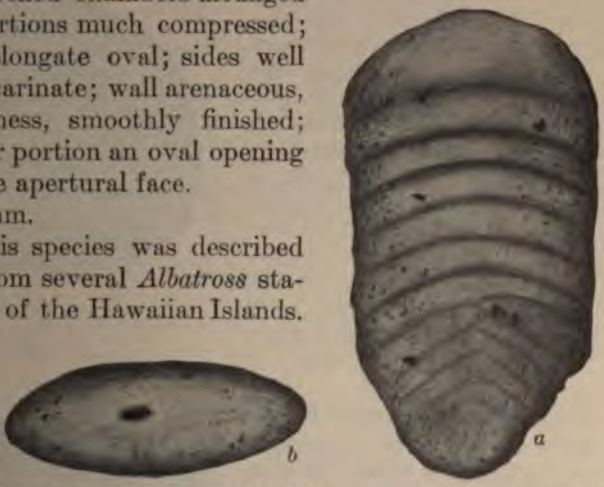


FIG. 50.—BIGENERINA ARENACEA. × 30. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

Although resembling *Bulimina* in some ways, its affir closer to *Textularia* and related genera. The aperture is asymmetrical to any extent, as claimed by Brady.

A study of the microspheric and megalospheric forms in ent species should be made to determine whether or no coiled chambers in the early development of the microsp

The species which exhibit a tendency toward a uniseria have been referred by some authors to *Bifarina*. Th species in the present series may be so placed.

### BOLIVINA PUNCTATA d'Orbigny.

*Bolivina punctata* D'ORBIGNY, Voyage Amér. Mérid., vol. 5, pt. nifères," 1839, p. 63, pl. 8, figs. 10–12.—H. B. BRADY, Trans. Li don, vol. 24, 1864, p. 468, pl. 48, figs. 9, *a*, *b*; Nat. Hist. Trans. No and Durham, vol. 1, 1865–67 (1867), p. 103, pl. 12, figs. 8 *a*, *b*.—MÖBIUS, Beitr. Meeresfauna Insel Mauritius, 1880, p. 94, pl. 9, figs. 9, 10.—TERRIGI, Atti Acc. Pont. Nuovi Lincei, vol. 33, 1880, p. 197, pl. 2, fig. 41.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 417, pl. 52, figs. 18, 19 —WOODWARD and THOMAS, 13th Ann. Rep. Geol. Nat. Hist. Surv. Minnesota for 1884 (1885), p. 169, pl. 3, fig. 12.—SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1886, p. 743, pl. 14, figs. 10 *a*, *b*.—MALAGOLI, Boll. Soc. Geol. Ital., vol. 7, 1889, p. 375, pl. 14, figs. 1–4.—TERRIGI, Mem. Com. Geol. d'Italia, vol. 4, 1891, p. 74, pl. 1, figs. 26–28.—WOODWARD and THOMAS, Geol. Nat. Hist. Surv. Minnesota, vol. 3, 1893, p. 34, pl. c, figs. 27, 28.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 298, pl. 8, figs. 1–3.—GOËS, Kongl. Svensk. Vet. Akad. Handl. vol. 25, No. 9, 1894, p. 49,

*Distribution.*—Generally recorded from the North Pacific by Brady. Goës records it from several stations in the eastern Pacific in 695–1,882 fathoms, and Bagg records it at a number of stations in the vicinity of the Hawaiian Islands, in 104–1,544 fathoms. I have found the species well scattered in the North Pacific material that I have examined. The deepest record is *Nero* station 2049, in 2,226 fathoms, off the Hawaiian Islands.

A considerable variety of smooth forms have been assigned to this species, as a study of the references quoted will show. That there are several species or varieties present seems most likely. The variety with a portion of each chamber smooth, without punctæ, as noted by Millett, was found off the southern coast of Japan, and there may be other varieties with a definite distribution were sufficient material available from the different oceans.

The elongate form is not greatly removed from some forms of *B. nobilis*, except for the striations of the latter.

### BOLIVINA DILATATA Reuss.

*Bolivina dilatata* Reuss, Denkschr. Akad. Wiss., Wien, vol. 1, 1850, p. 381, pl. 48, fig. 15.—Terrigi, Atti Accad. Pont. Nuovi Lincei, vol. 33, 1880, p. 197, pl. 2, fig. 42.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 418, pl. 52, figs. 20, 21.—Malagoli, Boll. Soc. Geol. Ital., ser. 4, vol. 6, 1887, p. 520, pl. 13, fig. 3.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 221, pl. 43, figs. 3, 6.—Terrigi, Mem. Com. Geol. d'Ital., vol. 4, 1891, p. 75, pl. 1, fig. 29.—Woodward and Thomas, Geol. Nat. Hist. Surv. Minnesota, vol. 3, 1893, p. 33, pl. c, fig. 26.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 294, pl. 8, figs. 17-20.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 50, pl. 9, figs. 482–486, pl. 14, figs. 5-10.—Egger, Jahr. 16, naturhist. Ver. Passau, 1895, p. 10, pl. 1, fig. 6.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 47.—Millett, Journ. Roy. Micr. Soc., 1900, p. 542.

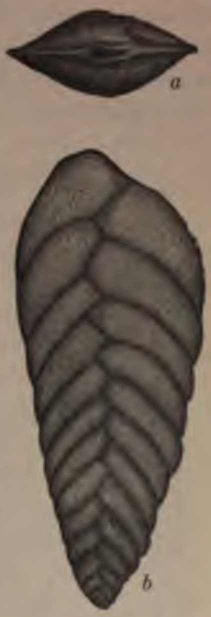


Fig. 54.—Bolivina dilatata. × 60. a, apertural view; b, front view.

*Description.*—Test cuneate, broadening rapidly toward the apertural end, the apical end small, blunt, much compressed, the edges thin; chambers numerous, broad and low, little inflated; sutures very distinct but hardly depressed; wall smooth, punctate; aperture elongate, narrow, ending at the edge of the inner border of the chamber; color white.

Length 0.3–0.6 mm.

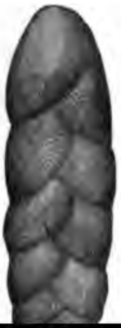
*Distribution.*—Recorded by Goës from the eastern portion of the North Pacific in 695–1,832 fathoms, and by Bagg from the Hawaiian Islands, in 275–1,544 fathoms, with the average depth below 400 fathoms.

I have had material from *Nero* station 990, in 859 fathoms, near Guam, and from stations about Japan, in the Inland Sea, and in Bering Sea, from depths ranging between 120 fathoms and 898 fathoms. Specimens were nowhere common.

Although Reuss' name has been used for all the broader forms which could not well be included under *B. punctata* d'Orbigny by various writers, there is, as is seen from a study of the present material, a definite species with the characters given above. It is apparently very distinct from *B. punctata*, with chambers of a very different form.

### BOLIVINA SEMINUDA, new species.

*Description.*—Test elongate, subcylindrical, very slightly compressed, the apical end rounded; chambers numerous, high, very slightly inflated, sutures nearly flush; wall hyaline, finely punctate except the lower half of each which has coarse foramina, otherwise smooth; aperture elongate, loop-shaped; color transparent and whitish about the lower half of each chamber.



Length up to 1 mm.

*Distribution.*—Specimens of this species were fairly common at two *Albatross* stations in Bering Sea, station H4025, in 536 fathoms, and station D4775 (type), on Bowers Bank, in 584 fathoms.

evenly rounded, the chambers numerous, high at the posterior outer edge each projecting backward in a spinose projection; wall smooth, punctate; aperture elongate; color white.

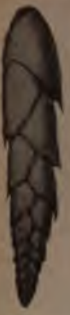


FIG. 56.—BOLIVINA BEYRICHI. × 50 (AFTER BRADY).

Length slightly less than 1 mm.

*Distribution.*—The only records in the North Pacific for this species are the two *Challenger* stations from which it was recorded by Brady, off the Philippines, in 95 fathoms, and on the *Hyalonema*-ground south of Japan, in 345 fathoms.

The figures of this species are very different, that of Hantken showing little it any of the posterior projections, and Egger's figure being very different from the usual form assigned to this species. From a study of the published figures and descriptions it seems very possible that our recent species may be found upon careful study to be different from the fossil.

### BOLIVINA BEYRICHI Reuss, var. ALATA (Seguenza).

*Vulvulina alata* SEGUENZA, Atti Accad. Gioenia Sci. Nat., ser. 2, vol. 18, 1862, p. 115, pl. 2, figs. 5, 5*a*.

*Bolivina alata* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 296, pl. 8, fig. 27.

*Bolivina beyrichi*, var. *alata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 422, pl. 53, figs. 2-4.

*Bolivina beyrichi*, var. *carinata* HANTKEN, Magy. kir. földt. int. évkönyve, vol. 4, 1875 (1876), pl. 7, fig. 12; Mitth. Jahrb. Ung. geol. Anstalt, vol. 4, 1875 (1881), pl. 7, fig. 12.

*Description.*—Test differing from that of the typical form of the species by the wide peripheral flange; it is also broader and much more tapering.

Length about 1 mm.

*Distribution.*—Brady records this variety from one North Pacific *Challenger* station off the Philippines, in 95 fathoms. There is a specimen (figured) in the material which I have examined from *Albatross* station H4025, in 536 fathoms, near the Aleutian Islands, which seems to belong here and is not unlike the specimen figured by Brady in pl. 53, fig. 2, of the *Challenger* report.

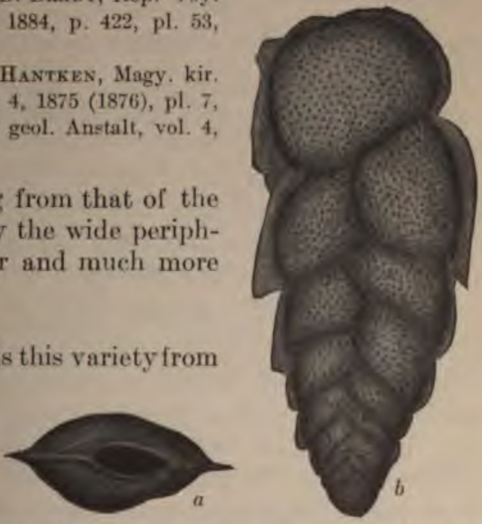


FIG. 57.—BOLIVINA BEYRICHI, VAR. ALATA. × 60. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

### BOLIVINA COMPACTA (Sidebottom).

*Bolivina robusta* H. B. BRADY, var. *compacta* SIDEBOTTOM, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 15, pl. 3, fig. 7.

*Description.*—Test elongate, tapering, the apex blunt-pointed, compressed, the edges rounded, the chambers numerous, somewhat inflated; sutures slightly depressed; surface areolated by the coalescence of the raised edges of the rather coarse punctæ; aperture elongate, with a slightly raised border; color silvery white.

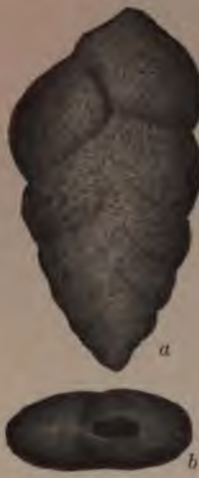


FIG. 58.—BOLIVINA COMPACTA. × 120. *a*, FRONT VIEW; *b*, END VIEW.

Length about 0.60 mm.

*Distribution.*—Specimens which agree well with the figure and description given by Sidebottom have been found at various stations in the North Pacific. The relation to *Bolivina robusta* does not seem to be close enough to make it a variety of that species, and so I have raised it to specific rank.

It was secured near the Hawaiian Islands at *Albatross* station H3007, in 323 fathoms, and at two *Nero* stations in the same region, from Guam, and from a *Nero* station near the Philippines.

### BOLIVINA ROBUSTA H. B. Bradv.

*Bolivina robusta* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 57; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 421, pl. 53, figs. 7–9.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 294, pl. 8, figs. 31, 32.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 543.—(?)CHAPMAN, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 32, pl. 4, fig. 82.—(?)BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 138.

*Bolivina acaulis* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 295, pl. 8, figs. 28–30.

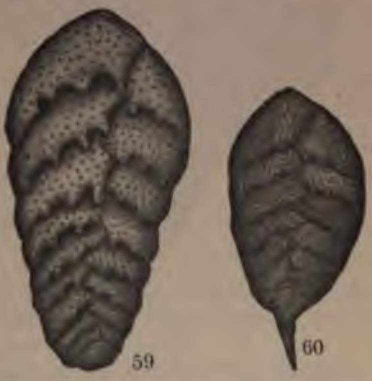
*Description.*—Test roughly triangular, tapering gradually to the apical end, which is either bluntly rounded or with a long, stout spine; apertural end very broadly rounded, almost obliquely truncate; test thickest at the median line, from which it slopes away to the fairly thin but rounded lateral edges; chambers numerous, longer than high, curved, in the later often crenulate with fairly deep reëntrants on the posterior margin; sutures scarcely depressed, limbate, curved; wall calcareous, thickly set with rather coarse perforations; aperture oval with a slightly raised lip; color white or gray,

Length about 0.50 mm.; microspheric proloculum 0.011–0.012 mm.; megalospheric proloculum 0.047–0.050 mm.

*Distribution.*—From the North Pacific, Brady records this species as occurring at three stations in from 7–345 fathoms, the last being on the *Hyalonema*-ground south of Japan. Bagg records it from the vicinity of the Hawaiian Islands, but not all of his selected set are of this species, and none of them are at all typical.

From the 1906 cruise of the *Albatross* there is a large number of specimens representing many stations ranging in depth from 59 to 500 fathoms, mostly off the southern coast of Japan, from the region from which some of Brady's material was obtained, with one or two stations in the Eastern Sea. From the *Nero* material the species is represented from stations south of Yokohama in 660 to 2,119 fathoms, the latter being at the only station in this area from which the species has been obtained from more than 1,500 fathoms. There are a few specimens from *Albatross* station H3007, near the Hawaiian Islands, in 323 fathoms, and from *Tuscarora* station 58, in 814 fathoms, south of the Bonin Islands.

In the material, microspheric and megalospheric specimens have been found at the same station, and the measurement of the proloculum in several cases has been obtained. There seems to be no tendency toward coiled young in the microspheric form, so far as seen.



Figs. 59-60.—Bolivina robusta. 59, spineless variety with deeply lobed chamber margin. × 100. 60, typical specimen with apical spine and less deeply lobed margin. × 70.

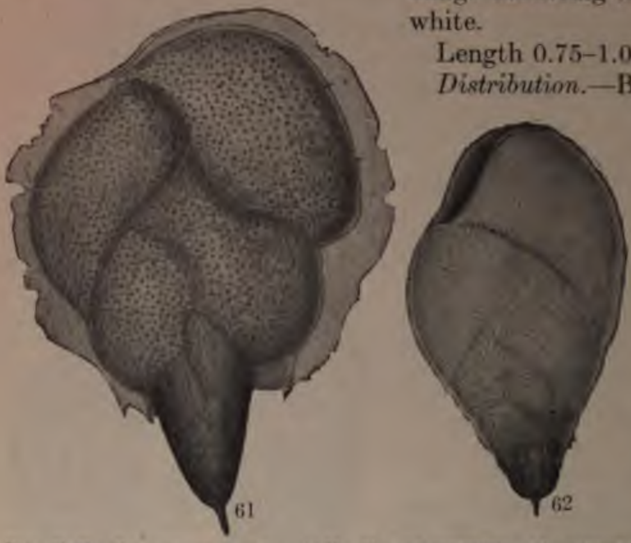
There is a considerable variation in the character of the lobulation of the posterior border of the chambers and in the presence or absence of the apical spine. Egger has described a species, *B. acaulis*, which seems to include those forms which lack the spine and have the lobulated margins of the chambers, but these characters are somewhat variable. The microspheric form is the more tapering of the two.

The figures show the extreme forms as made out in the material. The spineless form with the deeper lobulations is that called *B. acaulis* by Egger.

### BOLIVINA SEMIALATA Bagg.

*Bolivina semi-alata* Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 139, pl. 5, fig. 3.

*Description.*—Test broad, very much compressed, the early chambers in a conical, little compressed test, the later chambers broadening out, very much compressed, with a broad thin flange about the periphery; apical end acuminate, with a short, rather stout, spine; apertural margin very broadly rounded; posterior margin of the flange with short, posteriorly directed tooth-like projections; wall calcareous, thin, perforated with rather coarse perforations, smooth except for the apical end which may be slightly costa aperture long and narrow, bordered by a raised lip formed by t flange bordering the chamber; co white.



Figs. 61-62.—Bolivina semialata. × 75. 61, type-specimen. 62, another more regular specimen from the same region.

Length 0.75–1.00 mm.

*Distribution.*—Bagg described th species fro two specime from *Albatro* station H455 in 1,398 fat oms, near t Hawaiian I lands. Th type-specim is figured he the other w not seen.

I have had single specim from *Nero* st tion 2034, in 1 fathoms, also off the Hawaiian Islands. It is figured here. App ently it is a younger and less developed specimen of this same speci with the apical portion slightly costate.

### BOLIVINA SCHWAGERIANA H. B. Brady.

*Bolivina schwageriana* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 58; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 425, pl. 53, figs. 24, 25.—Millett, Journ. Roy. Micr. Soc., 1900, p. 547, pl. 4, fig. 10.

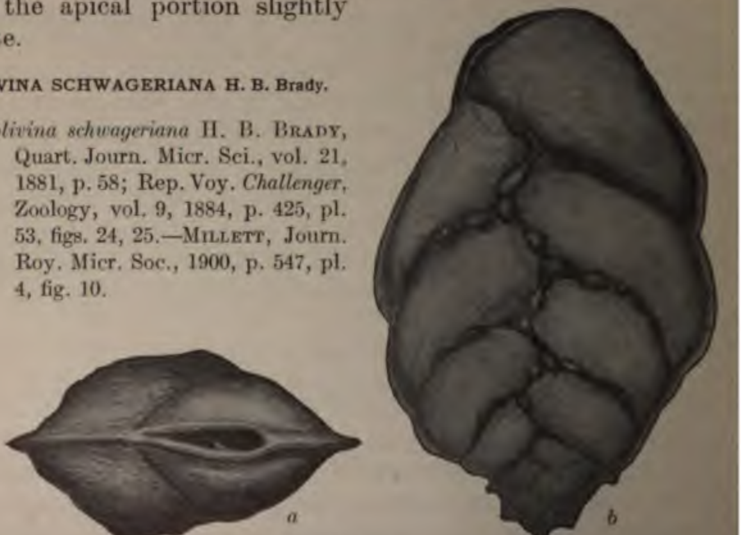


Fig. 63.—Bolivina schwageriana. × 65. a, apertural view; b, front view.

*Description.*—Test broad, a little longer than wide, compresse thickest in the median line, thence curving gently to the carinate m gins; apical end blunt, rounded; no keel developed on the early chambers, but in the later prominent though rather narrow; chambers well rounded; sutures limbate with raised beads near the junction with the chambers of the opposite series; wall calcareous, smooth except for the sutures and occasional costæ near the border of the test; aperture rather large, somewhat elongate, with an oblique projecting tooth; color white.

Length 0.50–0.65 mm.

*Distribution.*—This species has not previously been recorded from the North Pacific. Brady described it from specimens from Humboldt Bay, New Guinea, in 37 fathoms, and doubtful specimens from Torres Strait, in 155 fathoms. Millett records the species from the Malay Archipelago.

There are typical specimens from *Nero* station 1472, in 1,000 fathoms, near Guam. These are the only ones I have seen from the North Pacific. Apparently the species is limited to the Australasian region and the East Indian archipelago.

### BOLIVINA NOBILIS Hantken.

*Bolivina nobilis* Hantken, Magy. kir. földt. int. évkönyve, vol. 4, 1875 (1876), p. 56, pl. 15, fig. 4, Mitth. Jahrb. Ung. geol. Anstalt, vol. 4, 1875 (1881), p. 65, pl. 15, fig. 4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 424, pl. 53, figs. 14, 15.—Chapman, Quart. Journ. Geol. Soc., vol. 48, 1892, p. 516, pl. 15, fig. 11.—Millett, Journ. Roy. Micr. Soc., 1900, p. 541, pl. 4, fig. 4.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 32, pl. 4, fig. 81.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 138.

*Description.*—Test much elongated, slender, somewhat compressed; sides nearly parallel but tapering rather quickly to a blunt point at the apical end, apertural end obliquely truncate; chambers numerous, high, somewhat inflated; sutures slightly depressed; wall calcareous, the apical portion with fine longitudinal costæ, the apertural end smooth; aperture oval, in some specimens, where a uniserial condition is attained, remote from the border and subterminal, otherwise reaching to the preceding chamber as also in the young; color white.

Length up to 1.20 mm.

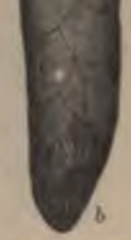


Fig. 64.—Bolivina nobilis. × 40. *a*, apertural view; *b*, front view.

*Distribution.*—All the *Challenger* stations for this species are in comparatively shallow water in the South Pacific. Bagg's records for the species are from *Albatross* station H4567, in 1,307 fathoms, and station H4696, in 367 fathoms, near the Hawaiian Islands. I have examined the specimens from these two stations and find that they are of the long slender type with finely costate apical ends.

I have specimens from five stations, *Albatross* station H2922, in 268 fathoms, station H3007 in 323 fathoms, *Nero* stations 2037 in 55 fathoms, 2064 in 1,355 fathoms and 2071 in 271 fathoms. All these five stations are close to the Hawaiian Islands.

These specimens as well as those which have been described by others are not very distinct from *B. punctata* except in the striations of the early chambers.

### BOLIVINA KARRERIANA H. B. Brady.

*Bolivina karreriana* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 58; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 424, pl. 53, figs. 19–21.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 299, pl. 8, figs. 38, 39.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 546.

*Description.*—Test elongate, tapering, the apical end occasionally rounded, but usually pointed with one large spine or two or more small ones; chambers comparatively few, inflated, sutures much depressed; wall calcareous, ornamented by longitudinal raised costæ, occasionally branching or anastomosing, continued even on the last-formed chamber; aperture broadly oval, subterminal, occasionally with a small tooth projecting into the orifice, bordered with a raised lip; color, white.

Length 0.50–0.80 mm.

*Distribution.*—Brady found this species abundant in material from the *Hyalonema*-ground south of Japan, in 345 fathoms. I have examined material from more than twenty stations, all in the region about Japan or to the southward. At some of these stations specimens are fairly common. The *Albatross* material from near the southern coast of Japan in most of stations from D4965 to D4975 contained this species. These stations are in the same region as the *Challenger* station mentioned above. They vary in depth from 191 to 905 fathoms. The species is well represented in the *Nero* material, mostly from the line of soundings between Guam and Yokohama. In depth these soundings range within the limits just given for the *Albatross* stations. In the *Tuscarora* material lately come under notice there is a single mounted specimen from station 2, which is south of the Hawaiian Islands, in 1,468 fathoms. The specimen is typical in all its characters.

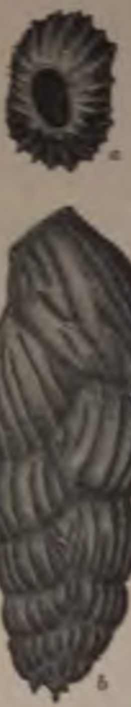


FIG. 65.—BOLIVINA KARRERIANA. × 80. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

The specimen recorded by Doctor Bagg from the vicinity of the Hawaiian Islands proves upon examination to be *Bulimina buchiana* d'Orbigny.

### BOLIVINA KARRERIANA H. B. Brady, var. CARINATA Millett.

*Bolivina karreriana* H. B. BRADY, var. *carinata* MILLETT, Journ. Roy. Micr. Soc., 1900, p. 546, pl. 4, fig. 8.

*Description.*—This variety has the test more compressed and larger than in the typical form, the aperture reaching to the preceding chamber instead of remote from it, and with the lateral borders distinctly carinate; the aperture is more elongate with a long tooth-like projection.

Length 0.75–0.80 mm.

*Distribution.*—Rare in the North Pacific, occurring but once, at *Nero* station 1472, in 1,000 fathoms, near Guam. Millett described this variety from the Malay Archipelago where it occurred at several stations.

Millett remarks upon the similarity of the variety to *B. hantkeniana* as well as to *B. karreriana*, and it may be that it is a distinct species. With but little available material I am leaving it as Millett has described it.

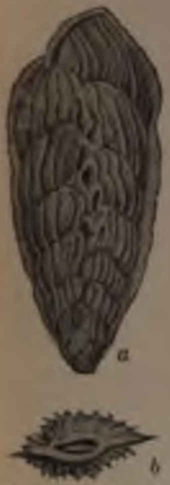


FIG. 66.—BOLIVINA KARRERIANA, VAR. CARINATA. × 60. *a*, FRONT VIEW; *b*, APERTURAL VIEW (AFTER MILLETT).

### BOLIVINA PUSILLA Schwager.

*Bolivina pusilla* SCHWAGER, *Novara*-Exped., Geol. Theil, pt. 2, 1866, p. 254, pl. 7, fig. 101.

*Description.*—Test elongate, tapering, composed of numerous rather low broad chambers, the apical end often with a very short spine, mucronate; wall ornamented with slightly raised longitudinal costæ, except at the apertural end where the chambers are usually smooth; aperture elongate, symmetrical; color, white.

Length about 0.40–0.60 mm.

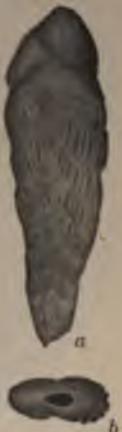


FIG. 67.—BOLIVINA PUSILLA. × 60. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

*Distribution.*—This species is well distributed in the North Pacific in fairly deep water. It occurred at a large number of *Nero* stations from the Hawaiian Islands westward and along the coast of Japan. The shallowest record is near Japan, at *Albatross* station H4878, in 84 fathoms, and the deepest, *Nero* station 2049, in 2,226 fathoms, near the Hawaiian Islands. The larger number of records are from depths between 1,000 and 1,500 fathoms.

These specimens seem to be identical with the species described by Schwager from the fossil deposits of Kar Nicobar. The loss of ornamentation in the later chambers of adult specimens is interesting.

### BOLIVINA HANTKENIANA H. B. Brady.

*Bolivina hantkeniana* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 58; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 424, pl. 53, figs. 16-18.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 296, pl. 8, figs. 40-42.—Millett, Journ. Roy. Micr. Soc., 1900, p. 546, pl. 4. fig. 9.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 137.

*Description.*—Test broad, much compressed, usually completely surrounded except at the aperture by a broad wing-like flange, either entire or variously lobed; chambers inflated somewhat; sutures very distinct, slightly depressed; wall calcareous, with a few short longitudinal costæ, usually confined to the limits of the chamber on which they originate; aperture narrow, oval, with a single tooth-like projection in the orifice; color, white.

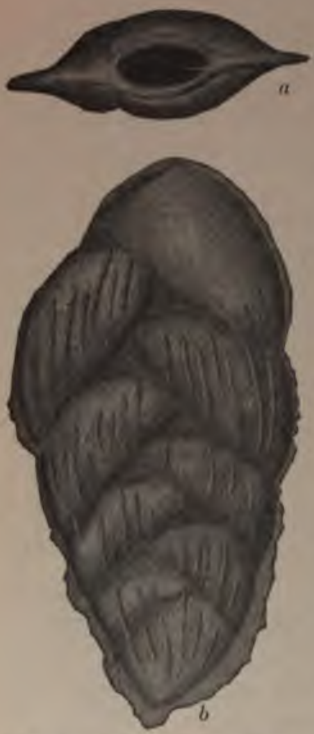


Fig. 68.—Bolivina hantkeniana. × 60. *a*, apertural view; *b*, front view.

Length 0.60–0.84 mm.

*Distribution.*—This species is recorded by Bagg from several *Albatross* stations in the vicinity of the Hawaiian Islands. While some of these specimens have the characters of this species, others I should refer to *B. beyrichi*, var. *alata*, and to *B. semialata*.

The only specimen I have which can without doubt be this species is from *Albatross* station D4970, in 500 fathoms, off the southern coast of Japan.

Brady's specimens were all from the Indo-Pacific region, and apparently this is a species limited to the warmer region from Australia northward, including the oceanic islands. This is the range of a large number of our species.

### BOLIVINA AMYGDALÆFORMIS H. B. Brady.

*Bolivina amygdalæformis* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 59; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 426, pl. 53, figs. 28, 29.

*Description.*—Test oval, compressed, the apical end round-pointed, the apertural end broadly rounded; chambers few, the sutures mostly hidden by the exterior ornamentation of the test, but showing slightly as darker lines; wall calcareous, ornamented by longitudinal costæ variously branching and anastomosing; terminal chamber, or sometimes the last two, nearly smooth, except for slight costæ at the lower border of the chamber, conspicuously and rather coarsely perforate; aperture terminal, in end view nearly central, long-oval, slightly constricted near the middle, bordered by a rounded raised lip; color, white or gray.

Length about 0.75 mm.

*Distribution.*—In the North Pacific, Brady records this species from *Challenger* station 209, in 95 fathoms, off the Philippines. I have seen specimens from two *Albatross* stations, D4875, in 59 fathoms, eastern channel of Korea Strait, and D4964, in 37 fathoms, off the southern coast of Japan. Brady also records the species from off the north coast of New Guinea, 1,070 fathoms, and in Torres Strait, in 155 fathoms.

The specimens I have had for study are of the same form and with the same details as those figured by Brady. The specimen figured by Egger[a] does not seem to be of this species and is referred elsewhere

### BOLIVINA PLICATA d'Orbigny.

*Bolivina plicata* D'ORBIGNY, Voyage Amér. Mérid., vol. 5. pt. 5, "Foraminifères," 1839, p. 62, pl. 8, figs. 4–7.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 138.

This species is recorded by Goës from *Albatross* station D3395, in 730 fathoms, but an examination of the selected material mounted by Goës from this station shows it to be a new species, later described.

Bagg records *B. plicata* from a single station near the Hawaiian Islands, but his mounted specimen is unfortunately difficult to study, and dismounting was not attempted.

I have found no material in the North Pacific referable to this species.

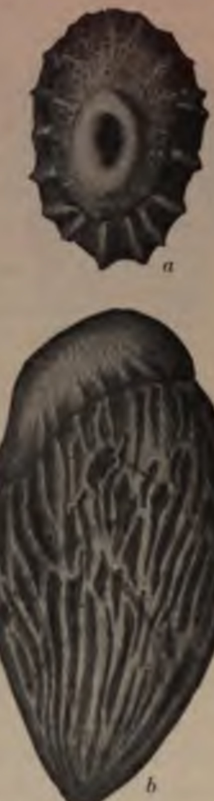


FIG. 69.—BOLIVINA AMYGDALÆFORMIS. × 75. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

### BOLIVINA SEMICOSTATA, new name.

*Bolivina costata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 426, pl. 53, figs. 26, 27 (not *B. costata* d'Orbigny, 1839).

*Description.*—Test broadly oval, two-thirds as broad as long, the ends obtusely rounded, somewhat compressed; chambers few, the sutures distinct, somewhat depressed; wall calcareous, ornamented with a number of raised rounded costæ running lengthwise of the test, somewhat irregular; last one or two chambers usually smooth, carinate; aperture, in end view, central, terminal, broadly oval, with a raised, rounded border; color white.

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[a] Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 299, pl. 8, fig. 45.

Length 0.60–0.75 mm.

*Distribution.*—I have specimens of this species from *Nero* station 990, in 859 fathoms, off Guam. The oval specimens of Brady referred to above were from off Raine Island, Torres Strait, in 155 fathoms; in Humboldt Bay, off New Guinea, in 37 fathoms; and off Amboina, in 15–20 fathoms. Goës's specimen[a] does not belong here.

This species differs in several important characters from the typical form described by d'Orbigny. From the available records the species seems to be limited to tropical or subtropical waters.

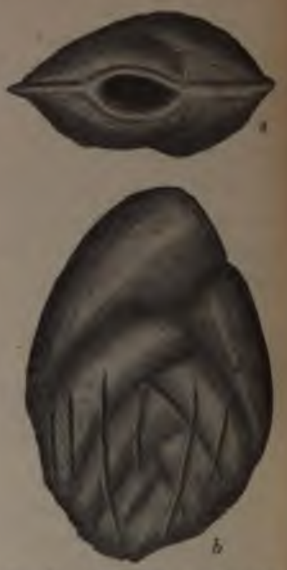

FIG. 70.—BOLIVINA SEMICOSTATA. × 75. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

**BOLIVINA ÆNARIENSIS (Costa).**

*Brizalina aenariensis* COSTA, Atti Acad. Pontaniana, vol. 7, 1856, p. 297, pl. 15, fig. 1, A, B.

*Bolivina aenariensis* H. B. BRADY, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 711, table; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 423, pl. 53, figs. 10, 11.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 221, pl. 43, figs. 2, 4, 5.—MALAGOLI, Boll. Soc. Geol. Ital., vol. 7, 1889, p. 377, pl. 14, figs. 11, 12.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 50.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 292, pl. 37, fig. 8.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 544.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 137 (part).

*Bulimina punctata* GOËS?, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, pl. 4, figs. 114, 115 (not *Bolivina punctata* d'Orbigny).

*Description.*—Test elongate, slightly tapering, much compressed, the edges carinate; apical end broadly rounded, often with a stout spine; apertural end rounded; chambers numerous, slightly inflated, the sutures curved, very slightly depressed; wall calcareous, smooth and punctate except for two or more longitudinal costæ, usually two long costæ extending well forward near the middle of the test, with shorter accessory ones near the apical end; aperture elongate-oval, with a continuation of the carina of the chamber forming a smooth raised lip about the opening; color white or gray.

Length up to 1.25 mm.

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[a] Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 48.

*Distribution.*—The species has been recorded by Brady at two North Pacific stations, off the Philippines, in 95 fathoms, and from the south coast of Japan, in 15 fathoms. Bagg records it from a number of *Albatross* stations near the Hawaiian Islands, but an examination of his material shows most of his specimens to belong to another species.

Typical specimens were found at a number of stations off the coast of Japan, in from 39–584 fathoms; also at three *Albatross* stations in Bering Sea, H4025, in 536 fathoms; D4781, in 482 fathoms; and D3608, in 276 fathoms. Specimens were abundant and large at station H2768, in 373 fathoms, near the coast of California. Specimens were also found at *Tuscarora* stations 32, in 309 fathoms, from the Californian coast; and 79, in 799 fathoms, near the Aleutian Islands.

The figured specimen did not have the typical long median costæ which are shown in Brady's figures and in the photographed specimens of Flint.

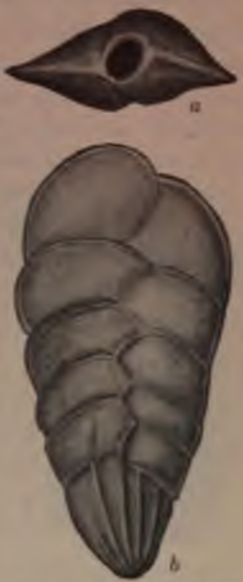
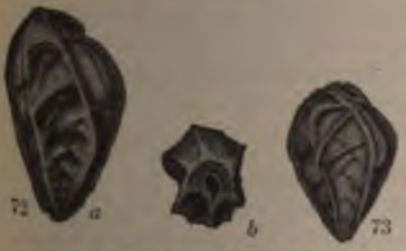


Fig. 71.—Bolivina ænariensis. × 40. a, apertural view; b, front view. Specimen without the long median costæ.

**BOLIVINA SUBANGULARIS H. B. Brady.**

*Bolivina subangularis* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 59; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 427, pl. 53, figs. 32, 33.—Millett, Journ. Roy. Micr. Soc., 1900, p. 545.

*Description.*—"Test oblong, tapering, stoutly built, more or less angular, somewhat concave or excavated on both sides; aboral extremity obtusely pointed. The angular contour of the transverse section is determined by the prominence of superficial costæ, the principal of which, six in number, are placed, one down each lateral margin, and two down each face of the test. Aperture comma-shaped."



Figs. 72-73.—Bolivina subangularis. × 60. 72, a, front view; b, apertural view. 73, front view of another specimen (after Brady).

Length 0.5 mm. or less.

*Distribution.*—Recorded by Brady from *Challenger* station 209, in 95 fathoms, off the Philippines. I have not found specimens referable to this species. The description and figures are from Brady.

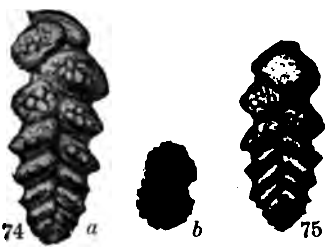
### BOLIVINA LOBATA H. B. Brady.

*Bolivina lobata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 58; Rep. Voy. *Challenger*. Zoology, vol. 9, 1884, p. 425, pl. 53, figs. 22, 23.

*Description.*—"Test elongate, depressed, digitate; distal end obliquely truncate or rounded, aboral extremity obtuse, peripheral margin lobulated. Segments inflated, their outer margins projecting and subangular; sutures thickened, and deeply sunk; surface, especially of the later chambers, more or less granulated. Aperture a long oval slit contracted at the middle; nearly central."

Length 0.40 mm.

*Distribution.*—This species was described by Brady from the region about New Guinea. I have found it at a single station, *Nero* station 1583, in 777 fathoms, between Guam and Midway Island. The granulations of the surface and the form are similar. Egger's figures[a] do not seem to represent this species, but it is hard to judge from the quality of the figures in that work. Millett's figure[b] closely resembles *B. lobata*, but its connection with the young of *Bigenerina fimbriata* Millett makes it certain that it is a young of that species. If *B. lobata* had such a uniserial development, it seems that Brady's material would have shown it. Therefore, for the present, it seems best not to unite it, but to keep it with the species as described by Millett. The resemblance is, however, so striking that it



FIGS. 74-75.—BOLIVINA LOBATA. × 80. 74, *a*, FRONT VIEW; *b*, APERTURAL VIEW (AFTER BRADY).

*Distribution.*—It is impossible to determine which of the two forms figured by Brady was obtained from the one North Pacific station given by him, Honolulu Reefs, 40 fathoms. However, an examination of Bagg's material labeled *B. textilarioides* shows the rough bordered form here described. In the *Nero* material I have had specimens from stations 2068, 2071, and 2074 in 307, 271, and 22 fathoms, respectively, the last being at Honolulu. Therefore Brady's specimens were probably of this species. There are also numerous specimens from the southern coast of Japan and from the area between Yokohama and Guam.

Millett recognized two distinct forms in the Malayan material. This spinose or granular form, at least in the North Pacific, seems to be the more common, no specimens which could be assigned to Reuss's species being seen.

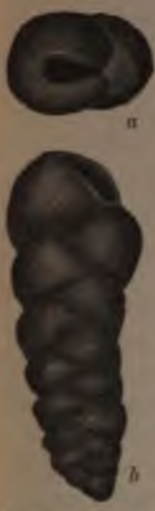


FIG. 76.—BOLIVINA SPINESCENS. × 75. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

### BOLIVINA DECUSSATA H. B. Brady.

*Bolivina decussata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 58; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 423, pl. 53, figs. 12, 13.

*Description.*—Test broad, tapering to the rounded apical end; apertural end obliquely truncate, compressed, the edges thick and square, or somewhat rounded; chambers numerous, the sutures indistinct, the surface ornamented with a series of rounded bosses, arranged more or less in vertical rows and also in oblique rows across the test; aperture rounded, with a raised border; color white.

Length 0.50 mm.

*Distribution.*—The only records for this species are those given by Brady from off Juan Fernandez in the South Pacific. What certainly seems to be this species has occurred at *Albatross* station D4839, in 140 fathoms, off Japan. The form is similar and the surface has the peculiar raised ornamentation shown in Brady's figures.

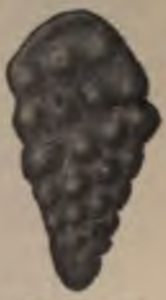


FIG. 77.—BOLIVINA DECUSSATA. × 120.

### BOLIVINA LIMBATA H. B. Brady.

*Bolivina limbata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 57; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 419, pl. 52, figs. 26-28.—HOWCHIN, Trans. Roy. Soc. South Australia, vol. 12, 1889, p. 8.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 300, pl. 8, figs. 10-12.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 543.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 15.—CHAPMAN, Journ. Linn. Soc., Zool., vol. 30, 1907, p. 32, pl. 4, fig. 83.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 138.

*Description.*—Test elongate, much compressed, gradually tapering to the rather bluntly-rounded apical end, often somewhat twisted, thickest along the median line, thinning toward the lateral margins, which are slightly rounded; chambers usually about as high as wide, slightly tumid, the sutures very distinct, irregularly curved, limbate, especially along the median portion of the face; wall calcareous, smooth, punctate; aperture elongate-oval, in some specimens somewhat remote from the border and terminal; color white.

Length 0.50–0.75 mm.

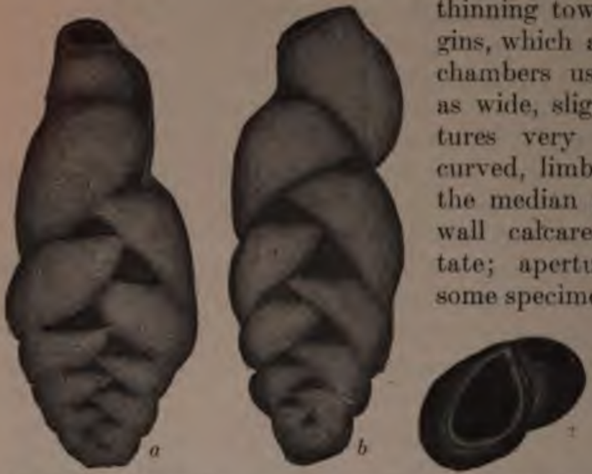


FIG. 78.—BOLIVINA LIMBATA. × 125. *a*, FRONT VIEW; *b*, SAME SPECIMEN FROM OPPOSITE SIDE; *c*, END VIEW.

*Distribution.*—Brady records the species from the following three stations in the North Pacific, off the Hawaiian Islands, in 40 fathoms, south shore of Japan, 15 fathoms, and in Hongkong Harbor, 7 fathoms. Bagg's specimen is from *Albatross* station H4694, in 865 fathoms, off the Hawaiian Islands.

In the material I have examined the species has been noted from the following stations: *Albatross* station D4965, in 191 fathoms, off the coast of Japan, and *Nero* station 1466, in 234 fathoms, near Guam.

There is a tendency in adult specimens to assume a uniserial development with a terminal aperture. From the other published records the species seems to be confined to fairly shallow tropical and subtropical waters.

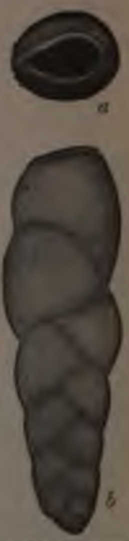


FIG. 79.—BOLIVINA (BIFARINA) PORRECTA. × 60. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

### BOLIVINA (BIFARINA) PORRECTA H. B. Brady.

*Bolivina porrecta* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 57; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 418, pl. 52, fig. 22, *a*, *b*, *c*.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 300, pl. 8, figs. 7–9, 46, 47.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 292, pl. 38, fig. 2.

*Bifarina porrecta* MILLETT, Journ. Roy. Micr. Soc., 1900, p. 540, pl. 4, fig. 3.

*Description.*—Test elongate, slightly tapering, the apex rounded; apertural end truncate, compressed, the edges rounded, the chambers high, the later triangular, the sutures in later growth passing entirely across the test and forming an almost uniserial stage; wall smooth, perforate; aperture subterminal, removed from the inner edge of the chamber, elongate, with a raised border; color white. Length 0.75–0.84 mm.

*Distribution.*—Not previously recorded from the North Pacific, but known from off Tahiti, the north coast of New Guinea, and from the Malay Archipelago. The only North Pacific station at which I have found the species is *Albatross* station D4875, in 59 fathoms, eastern channel of Korea Strait. This material is typical.

This species is referred to *Bifarina* by Millett, and if that genus be recognized that is its logical position.

### BOLIVINA (BIFARINA) STRIGOSA (H. B. Brady).

*Bolivina lobata*, var. *strigosa* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 425, pl. 113, fig. 7.

*Description.*—Test elongate, slightly tapering, compressed; chambers triangular, the outer posterior angle extending outward, giving a very lobulated margin to the test; wall perfectly hyaline, except at the border, where it is partially white and opaque; sutures distinct, extending across the test in the later chambers; aperture elongate, subterminal, removed from the inner border of the chamber, surrounded by a raised lip; color transparent, white.

Length 0.40 mm.

*Distribution.*—Brady described this as a variety of *B. lobata* from Torres Strait. The figured specimen from *Nero* station 1310, in 518 fathoms, between Yokohama and Guam, is in every respect identical with Brady's specimen. The resemblance to *B. lobata* seems to be remote, and it is here considered as a distinct species.

In this same region and at corresponding depths many of the other species described from Torres Strait are found, and it is not surprising to find this rare form here also. The arrangement of the last-formed chambers strongly suggests *Bifarina*.

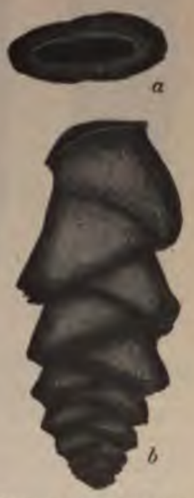


FIG. 80.—BOLIVINA (BIFARINA) STRIGOSA. × 120. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

## Genus PLEUROSTOMELLA Reuss, 1860.

*Nodosaria* (part) REUSS, Verst. Böhm. Kreid., pt. 1, 1845, p. 28.

*Dentalina* (part) REUSS, Haidinger's Nat. Abhandl., vol. 4, 1850, p. 24.

*Pleurostomella* REUSS (type, *P. subnodosa* Reuss.), Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 203.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 410.

*Description.*—Test elongate, somewhat compressed, composed of numerous chambers, usually biserially arranged; wall calcareous,

perforate, smooth or ornamented; aperture distinctive, a
opening with a vertical notch or slit in the middle of the lo
usually with tooth-like projections upward at either side.

The aperture is really the distinguishing character of t
It differs much from that of the other genera of the fa
there are considerable differences in the various species, s
ing a simple vertical slit without teeth, others a broad n
a well developed tooth at each side. This wall containin
or notch is usually well within the arched space, and is n
easy to see when examining material. There are several
species, but none of them seem
all common. None of the spe
previously been recorded from t
Pacific.

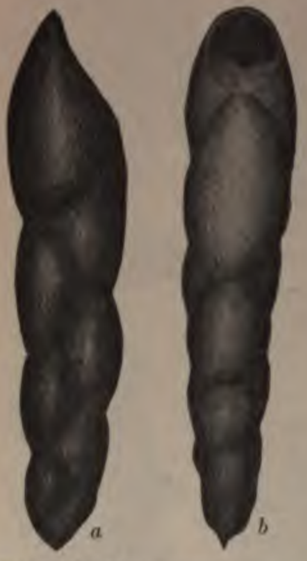


FIG. 81.—PLEUROSTOMELLA ALTERNANS. × 60. *a*, FRONT VIEW; *b*, VIEW SHOWING APERTURE.

### PLEUROSTOMELLA ALTERNANS Sc

*Pleurostomella alternans* SCHWAGE
Exped., geol. Theil, vol. 2, 1
pl. 6, figs. 79, 80.—TERRIGI,
Accad. Pont., ann. 33, 1880, p.
fig. 46.—H. B. BRADY, Rep.
*lenger*, Zoology, vol. 9, 1884, p.
figs. 22, 23.—CHAPMAN, Proc.
London, 1895, p. 25.

*Description.*—Test elongat
pressed, very gradually tapering
subacute base; apertural end
front view, in side view broadly
chambers numerous, longer than
tures slightly depressed; apertur
arched; notch of the lower wa
almost semicircular, with an
pointed tooth projecting forward on each side; wall sm
polished; color white.

Length 0.60–0.85 mm.

*Distribution.*—There is a single specimen in the collect
*Albatross* station D2806, in 1,379 fathoms, off the Galapago
It has not been met with in material from any other pa
North Pacific.

Whether or not this species is really *P. alternans* Schwage
open to question. That species, as the original figures sh
very high vertical wall in which the aperture is seen near t
a relatively small opening. In the recent specimens fig
opening is much larger and broader.

### PLEUROSTOMELLA SUBNODOSA (Reuss).

*Nodosaria nodosa* Reuss (part), Verst. Böhm. Kreid., pt. 1, 1845, p. 28, pl. 13, fig. 22.

*Dentalina subnodosa* Reuss (part), Haidinger's Nat. Abhandl., vol. 4, 1850, p. 24, pl. 1, fig. 9.

*Pleurostomella subnodosa* Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 204, pl. 8, fig. 2*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 412, pl. 52, figs. 12, 13.—Chapman, Proc. Zool. Soc. London, 1895, p. 25.

*Description.*—Test much elongated, very slightly compressed, nearly cylindrical, hardly tapering, the apical end broadly rounded, the apertural end subacute in front view, rounded in side view; chambers several, the very early ones biserial, the later uniserial, but with oblique sutures showing the traces of the biserial condition; aperture fairly broad; sinus broad with slight projections at each side; color white.

Length 0.65–0.90 mm.

*Distribution.*—Apparently this species is more common in the North Pacific than the preceding. It was found in material from *Tuscarora* station 2, in 1,468 fathoms, in the southwestern Pacific, *Nero* station 842, in 1,330 fathoms, off the coast of Luzon, Philippine Islands, and at *Nero* stations 1294 and 1299, in 1,417 and 1,817 fathoms, south of Japan.

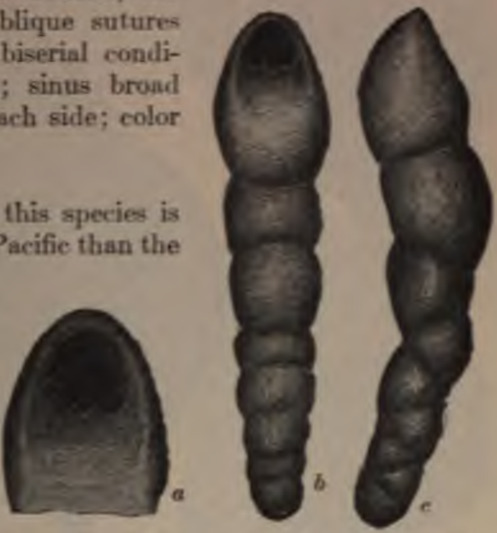


Fig. 82.—Pleurostomella subnodosa. *a*, aperture. × 150; *b*, front view; *c*, side view. × 75.

The early portions of the test show biserially arranged chambers and the later ones while uniserial are really a biserial series, which shove one another apart, as is seen by the arrangement of the sutures and the wedge-shaped chambers alternating from side to side as added.

### PLEUROSTOMELLA SPINOSA, new species.

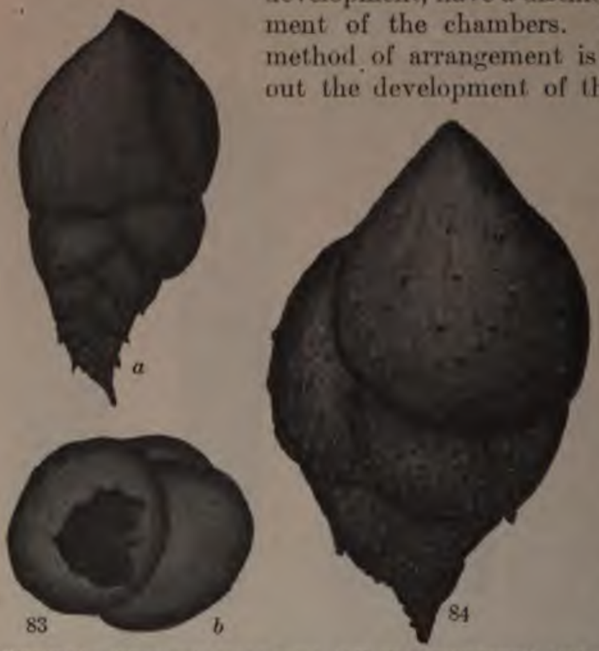
*Description.*—Test broad, abruptly tapering to the acute spinose apical end; chambers several, greatly increasing in size in the adult, broad and much inflated, the sutures deep; surface with numerous very short subacute spines, either over all the chambers or limited to the earlier ones; aperture with the sinus a narrow slit with bluntly rounded short teeth at the sides; color white.

Length 0.50–0.70 mm.

*Distribution.*—Type-specimen (Cat. No. 8339, U.S.N.M.) fro
*Albatross* station D4970, in 500 fathoms, off Japan. Two othe
specimens were found at this station.

This species differs from the other abruptly tapering species of th
genus by its more depressed sutures and its spinose surface.

### Subfamily 3, VERNEUILININÆ.



FIGS. 83-84.—PLEUROSTOMELLA SPINOSA. × 75. 83, *a*, FRONT VIEW; *b*, APERTURAL VIEW WITH THE UPPER END OF THE CHAMBER SLIGHTLY BROKEN AND JAGGED. 84, FRONT VIEW OF ANOTHER MORE INFLATED SPECIMEN.

This subfamily includes those genera which, at least in their earl
development, have a distinctly triserial arrange
ment of the chambers. In *Verneuilina* thi
method of arrangement is continued through
out the development of the test, but in othe
genera become
variously modi
fied. In *Gaudry*
*ina* the early por
tion of the test i
triserial and th
adult arrange
ment is biseri
and comparable t
*Textularia.* I
*Clavulina* ther
is still anoth
regressive st
and the young a
triserial, whi
the adult arrang
ment is uniseri
with a centr
aperture.

## Genus VERNEUILINA d'Orbigny, 1840.

*Verneuilina* D'ORBIGNY (type, *V. tricarinata* d'Orbigny), Mém. Soc. Gé
France, ser. 1, vol. 4, 1840, p. 38.—H. B. BRADY, Rep. Voy. *Challeng*
Zoology, vol. 9, 1884, p. 382.

*Bulimina* (part), REUSS, Verst. Böhm. Kreid., pt. 2, 1845, p. 109, and other a
thors.

*Polymorphina* (part), SCHULTZE, Organ. Polyth., 1854, p. 61.

*Textularia* (part), PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 186
p. 371 and other authors.

*Description.*—Test free, more or less elongate, tapering, in cro
section rounded or triangular, composed of a series of chambe
spirally arranged, but in three vertical columns; walls variabl
arenaceous or hyaline; aperture a slit at or near the base of the inn
margin of the chamber.

In general the genus *Verneuilina* may be used to include all the definitely triserial species which have a slit-like aperture at the base of the inner margin of the chamber. This is apparently the primitive genus from which have developed such genera as *Gaudryina*, and in its relations to *Textularia*, *Verneuilina* may be taken as the simplest member of the subfamily *Verneuilininæ*. It includes a number of well characterized species, some of them rather common and of wide distribution.

### VERNEUILINA POLYSTROPHA (Reuss).

*Bulimina polystropha* REUSS, Verst. Böhm. Kreid., pt. 2, 1845, p. 109, pl. 24, fig. 53.
*Verneuilina polystropha* PARKER and JONES, Introd. Foram., 1862, p. 311.—H. B. BRADY, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 436, pl. 20, figs 9a–c.

*Description.*—Test elongate, conical, triserial, the apical end bluntly rounded, the chambers somewhat inflated; wall coarsely arenaceous, the surface rough; aperture at the base of the inner margin of the chamber, in a depression formed at the junction of the three chambers, rounded or oval; vertical columns of chambers usually spirally twisted; color reddish brown.

Length 0.50–1.0 mm.

*Distribution.*—This shallow water species has heretofore not been recorded from the North Pacific. Specimens from two *Albatross* stations, H2681, in 486 fathoms, and H2772, in 343 fathoms, off the western coast of the United States, seem referable to it as figured by Brady. Whether this is really the species described by Reuss from the cretaceous is very doubtful, but for the present it is so considered.

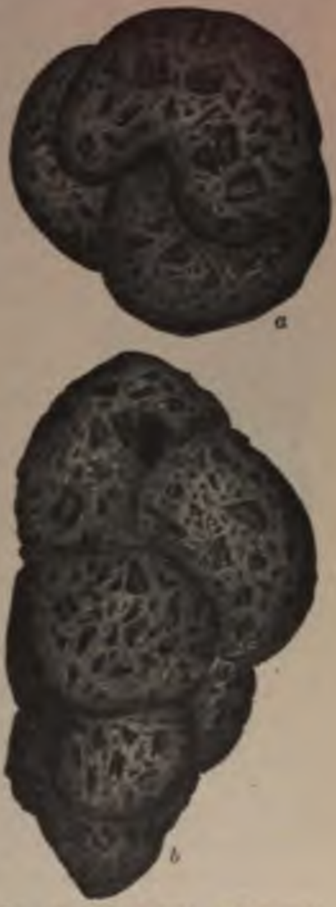


FIG. 85.—VERNEUILINA POLYSTROPHA. × 30. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

### VERNEUILINA PROPINQUA H. B. Brady.

*Verneuilina propinqua* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 387, pl. 47, figs. 8–12 [not 13, 14].—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 33, pl. 7, figs. 264–266.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 285, pl. 21, fig. 2.

*Description.*—Test free, pyramidal, triserial, the apical end bluntly rounded; chambers well inflated but closely set; wall coarsely arena-

[illegible] chambers are stri[illegible] tendency tow[illegible]

[illegible]

[illegible] Rep. Voy. [illegible] fig. 1. [illegible]

[illegible] the tri[illegible] arenace[illegible] in each vertica[illegible] usually polis[illegible] the base of [illegible] occasionally [illegible]

[illegible] species is wi[illegible] all the oce[illegible] are those [illegible] *Challenger* [illegible] 1,125 fathoms. [illegible] occurred u[illegible] 1,000 fathoms [illegible] that it did not occur in the 1906 soundings from about Japan. Most of the work done here, however, was in more shallow water.

There has been considerable doubt in the minds of various authors as to the correctness of assigning our recent species to the somewhat incomplete figure of *Bulimina pygmæa* given by Egger.[a] Brady remarks upon the doubtfulness of using Egger's name for this species. Goës also is inclined to question the identity.

From a study of the available data it seems to me very unwise to refer our well characterized recent species to the very doubtful and ill characterized fossil species. Egger's figure does not at all represent our common recent species nor does the later figure given by Goës.[b] Neither *Textilaria triseriata* Terquem nor *Verneuilina rotundata* Karrer are clearly this species, certainly not the former, although both are included by Brady under *V. pygmæa*. In such a case it seems best to use a new name for our recent species, and from the clear description and excellent figures given by Brady his name is used here for the species.

An examination of the series selected by Goës shows that a part of his specimens referred to *V. propinqua* are in reality *V. bradyi* and not *V. propinqua* H. B. Brady.

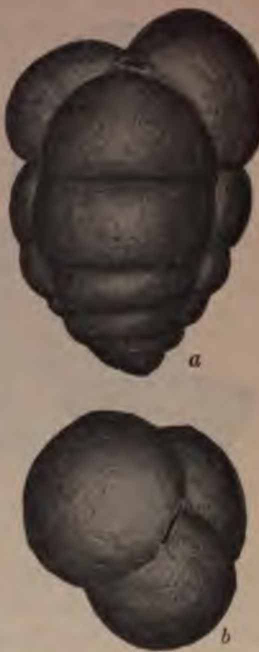


FIG. 87.—VERNEUILINA BRADYI. × 40. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

### VERNEUILINA SPINULOSA Reuss.

*Verneuilina spinulosa* Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 12.—Egger, Neues Jahrb., 1857, p. 292, pl. 9, figs. 17, 18.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 384, pl. 47, figs. 1-3.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 219, pl. 42, fig. 15 (not fig. 14).—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 472.—Millett, Journ. Roy. Micr. Soc., 1900, p. 11.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 10, pl. 2, fig. 5.—Rhumbler, Zool. Jahrb., Abth. Syst., vol. 24, 1906, p. 61, pl. 5, fig. 53.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 132.

*Description.*—Test pyramidal, three-sided, triangular in transverse section, the sides flat or slightly concave, the initial end acutely pointed; initial end and angles of chambers often with sharp spines; walls of medium thickness, hyaline, or in some cases thickened and rough, perforate, smooth or granular; apertural end of test bluntly angled, the edges of the chambers thickened; aperture a curved slit at the base of the inner edge of the chamber.

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[a] Neues Jahrb. für Min., 1857, p. 284, pl. 12, figs. 10, 11.

[b] Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 33, pl. 7, figs. 262, 263.

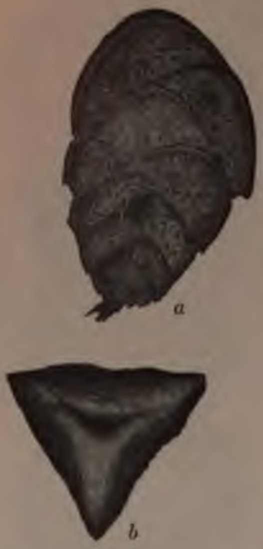


FIG. 88.—VERNEUILINA SPINULOSA. × 60. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

Length 0.25–0.75 mm.

*Distribution.*—This species seems to be widely distributed in the North Pacific. Brady records it from four *Challenger* stations in this area, the extremes of depth being 7 and 2,300 fathoms. Rhumbler notes its occurrence at Laysan Island, and Bagg records it from five *Albatross* stations near the Hawaiian Islands in from 275 to 865 fathoms.

I have had material from a considerable number of stations in the North Pacific, all but two of which were from depths greater than 100 fathoms. Brady found that but 7 of his 24 stations for this species were in depths greater than 100 fathoms. The greatest depth at which material was taken including this species was 1,355 fathoms in the *Nero* soundings near the Hawaiian Islands. Nearly all the specimens examined were from south of 30° north.

### VERNEUILINA AFFIXA, new name.

*Verneuilina propinqua* H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 387, pl. 47, figs. 13, 14 [not figs. 8–12].—GOËS (part), Bull. Mus. Comp. Zoöl, vol. 29, 1896, p. 38.

*Description.*—Test affixed, pyramidal, tapering to a rather acute point at the apical end, triserial except at the attached end, which may be biserial in the attached chambers; test usually somewhat curved; wall coarsely arenaceous, but only slightly roughened on the surface; aperture at the base of the inner margin of the chamber in an elongated depression formed by the last formed whorl of chambers, rounded or somewhat elongate; color reddish brown, except the attached chambers and the area of attachment about the chambers, which are light gray.

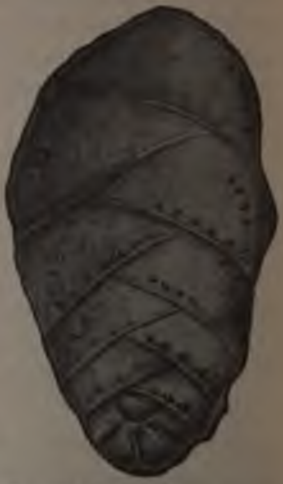
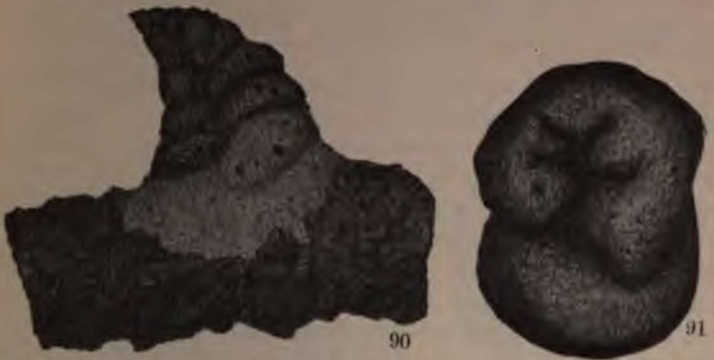


FIG. 89.—VERNEUILINA SPINULOSA (?). × 60. SPECIMEN WITH COILED YOUNG.

Length up to 4 mm.

*Distribution.*—As Brady includes this under *Verneuilina propinqua*, it is impossible to know at which stations this species occurred without consulting his material. Goës's specimens, one of which is figured here, were from *Albatross* station D3419, in 772 fathoms, off the west coast of Mexico, attached to tubes of *Rhabdammina irregularis* W. B. Carpenter.



FIGS. 90-91.—VERNEUILINA AFFIXA. × 25. 90, SPECIMEN ATTACHED TO RHABDAMMINA. 91, APERTURAL VIEW OF DETACHED SPECIMEN.

This species is different in every way from typical *V. propinqua* H.B. Brady. It is higher and more tapering, and is usually distinctly bent toward the tip. The chambers are more numerous and less inflated, the later with a tendency to become biserial; and it differs also in the attached habit with its consequent modifications of the apertural portion of the test.

The light gray or white border of loose material about the area of attachment appears to be common to a large number of attached forms which are not at all related.

### VERNEUILINA PUSILLA Goës.

*Verneuilina pusilla* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 39, pl. 5, figs. 6-8.

*Description.*—"Short, often nearly cylindrical, with very little inflated segments, or sometimes ovoid with inflated segments; aperture a sutural slit or an obliquely set comma-formed fissure. Pale yellow or whitish."

Length 0.50-0.66 mm.

*Distribution.*—This species was described by Goës from *Albatross* station D3431, in 995 fathoms, at the entrance of the Gulf of California.

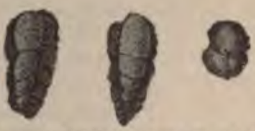


FIG. 92.—VERNEUILINA PUSILLA (AFTER GOËS).

I have carefully examined the mounted set returned to the U. S. National Museum by Goës from the above station and labeled *Verneuilina pusilla* Goës on the original label. The specimens do not fit the description or figures at all well, but many of the figures of the paper quoted are very poor when compared with the specimens. I should place these specimens under *V. polystropha* Reuss, as they seem to have all the characteristics of Brady's figures of that species.

The above description is taken from Goës.

### Genus VALVULINA d'Orbigny, 1826.

*Valvulina* d'Orbigny (type, *V. triangularis* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 270.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 391.
*Rotalina* (part) Williamson, Rec. Foram. Great Britain, 1858, p. 55.

*Description.*—Test spiral, conical, with three chambers in a whorl, umbilicate, usually attached; wall arenaceous, fairly smooth; aperture provided with a valvular tooth; color usually reddish brown, area of fixation white or light gray.

The genus *Valvulina* as designated by d'Orbigny includes various fossil forms which differ somewhat in shape from our recent species but only in minor points. Typically the test is attached but it is not always found in place. The area of fixation is large.

The genus is best represented by fossil species, the recent ones being few and specimens rare.

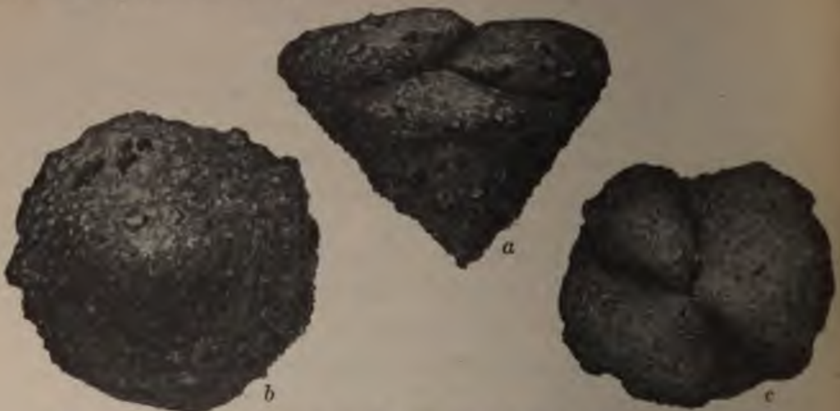


Fig. 93.—Valvulina conica. × 40. *a*, front view; *b*, from above; *c*, from below.

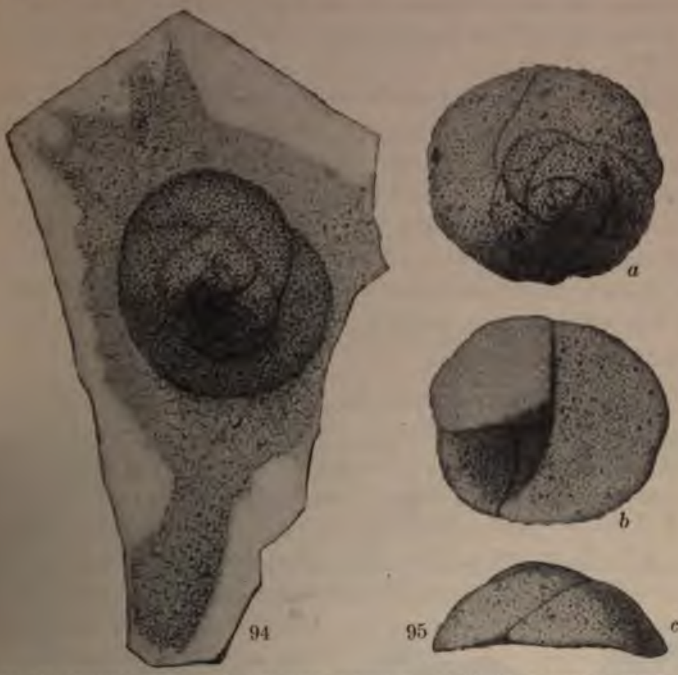
#### VALVULINA CONICA (Parker and Jones).

*Valvulina triangularis* Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 295, pl. 11, figs. 15, 16 (not *Valvulina triangularis* d'Orbigny).
*Valvulina triangularis*, var. *conica* Parker and Jones, Philos. Trans. Roy Soc., vol. 155, 1865, p. 406, pl. 15, fig. 27.
*Valvulina conica* M. Sars, Vid. Selsk. Forh., 1868, p. 249.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 392, pl. 49, figs. 15, 16.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 220, pl. 41, fig. 21; pl. 42, figs. 16, 17.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 39, pl. 8, figs. 342-352.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 286, pl. 31, fig. 3.

*Description.*—Test typically attached, conical, often with the axis somewhat curved, the apical end bluntly pointed, the affixed end flat and truncate, even concave; chambers arranged spirally, but so as to form a triserial test; wall coarsely arenaceous, rough or fairly smooth on the surface; aperture slit-like, at the inner basal margin of the chamber, protected by a valvular lip; early chambers dark reddish brown, the later becoming lighter; area of attachment light gray.

Diameter about 0.50 mm.

*Distribution.*—There are no previously published records for this species in the North Pacific. The only specimens obtained from the material examined were from *Albatross* station H2922, in 268 fathoms, near the Hawaiian Islands.



FIGS. 94-95.—VALVULINA FUSCA. 94, ATTACHED SPECIMEN. × 40. 95, *a*, DORSAL VIEW; *b*, VENTRAL VIEW; *c*, SIDE VIEW. × 50 (AFTER BRADY).

### VALVULINA FUSCA (Williamson).

*Rotalina fusca* WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 55, pl. 5, figs. 114, 115.—TERQUEM, Ess. Anim. Plage Dunkuerque, 1875, p. 26, pl. 2, figs. 6, *a*, *b*.

*Valvulina fusca* M. SARS, Vid. Selsk. Forh., 1868, p. 249.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 392, pl. 49, figs. 13, 14.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 39, pl. 8, figs. 353–355.

*Valvulina triangularis*, var. *austriaca* PARKER and JONES, Introd. Foram., 1862, p. 311.

*Valvulina austriaca* H. B. BRADY, Trans. Linn. Soc. London, vol. 24, 1864, p. 472.

*Description.*—Test typically attached, low conical, depressed, rounded, the affixed end concave; chambers spirally arranged, with only three chambers in each whorl; wall finely arenaceous, smooth;

aperture slit-like, at the inner basal margin of the chambe
tected by a valvular lip; early chambers reddish brown, th
yellowish brown; area of attachment light gray.

Diameter 0.50–0.65 mm.

*Distribution.*—The only record for this species in the North
is that given by Brady from near the Philippines, in 95 fa
I have not met with the species in the material which I have exa

## Genus CHRYSALIDINA d'Orbigny, 1846.

*Chrysalidina* D'ORBIGNY (type, *C. gradata* d'Orbigny), For. Foss.
1846, p. 194.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol.
p. 387.

*Description.*—Test many chambered, triserial, at least in th
portion, tapering; apertures numerous, scattered over th
minal wall of the chamber; other walls also porous.

This genus includes two species, one a fossil from the cretaceou
Vienna basin, the other a very rare recent species occurring in s
water in the warmer portion of the Pacific and Indian Oceans

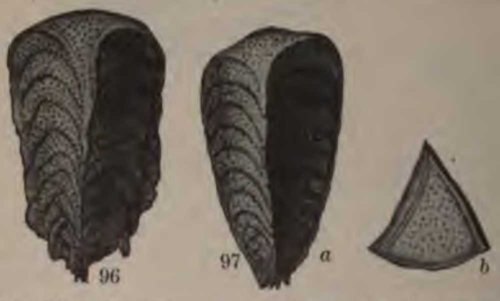
It is rather probable that these two species are not gene
related, but until more is known about them they may be cons
as belonging to one genus.

### CHRYSALIDINA DIMORPHA H. B. Brady.

*Chrysalidina dimorpha* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 2
p. 54; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 388, pl. 46, figs.
EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893,
pl. 6, figs. 47, 51, 52.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 12, pl.

*Description.*—Test free, elongate, tapering, triangular in cro
tion, the sides nearly equal, somewhat concave, the edges s
carinate; early
acute, consisting of
bers arranged tris
the later portion
posed of chambe
ranged in a single
wall hyaline, per
apertures numero
the broadened te
face of the chambe

Length about 0.5
diameter about 0.2



FIGS. 96-97.—CHRYSALIDINA DIMORPHA. × 70. 97, *a*, FRONT VIEW; *b*, APERTURAL VIEW (AFTER BRADY).

*Distribution.*—This species is known from the warmer porti
the Pacific and Indian Oceans, almost entirely from shallow wa
from shore sands. The only published North Pacific records are
by Brady: Coral reef of Honolulu, in 40 fathoms· Hongkong H
in 7 fathoms.

## Genus TRITAXIA Reuss, 1860.

*Textularia* (part) Reuss, Verst. Böhm. Kreid., pt. 1, 1845, p. 39.
*Tritaxia* Reuss (type, *T. tricarinata* (Reuss) = *Textularia tricarinata* Reuss), Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 228.—H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 388.

*Description.*—Test triserial, at least in the earlier portion, usually triangular in cross section; aperture central and terminal with or without a distinct neck and lip, rounded; wall usually arenaceous.

This genus, as defined by Reuss and employed by Brady, includes those triserial forms which in their earlier development are like *Verneuilina* and have a textularian aperture, later changing their plan of development so that the newly added chamber occupies nearly or quite the whole of the apertural end of the test. With this change in the chamber comes a change in the aperture to a terminal position and a corresponding change in shape to a circular opening, usually with a raised lip, and in some species with a definite tubular neck as well.

A new genus has been erected for *T. caperata* H. B. Brady, which is in many ways different from other species of *Tritaxia*.

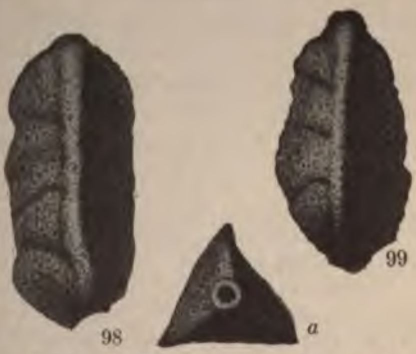
### TRITAXIA TRICARINATA (Reuss).

*Textularia tricarinata* Reuss, Verst. Böhm. Kreid., pt. 1, 1845, p. 39, pl. 8, fig. 60.
*Tritaxia tricarinata* Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p, 228, pl. 12, figs. 1, 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 389, pl. 49, figs. 8, 9.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 39.

*Description.*—Test elongate, triangular in cross section, the edges carinate, the apical end bluntly rounded, the sides slightly concave; apertural aspect triangular; wall rather coarsely arenaceous, fairly smooth, the sutures rather indistinct; aperture in adult specimens rounded, central, terminal, often with a short neck; color brown.

Length about 1 mm.

*Distribution.*—Goës records this species as rare in the Pacific (referring to the southeastern portion of the North Pacific), in 900 fathoms. None of the Pacific stations from which Goës had material is exactly 900 fathoms in depth, although several are near it. Under the lists by stations this species does not occur from the Pacific list, and there are no specimens in the lot returned by Goës. Therefore the record rests solely upon the published work of Goës.



Figs. 98-99.—Tritaxia tricarinata. × 35. 98, *a*, apertural view (after Brady).

It is a question whether Brady was correct in assigning the recent form which occurred only off Torres Strait to the cretaceous species described by Reuss. In the absence of material this point can simply be suggested as open to question.

## Genus GAUDRYINA d'Orbigny, 1839.

*Gaudryina* d'Orbigny (type, *G. rugosa* d'Orbigny), in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 109; Mém. Soc. Géol. France, ser. 1, vol. 4, 1840, p. 43; For. Foss. Vienne, 1846, p. 197.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 377.

*Heterostomella* Reuss, Sitz. Akad. Wiss. Wien, vol. 52, pt. 1, 1865, p. 448.

*Description.*—Test free, composed of two distinct portions, the earlier consisting of a series of chambers arranged triserially, followed by a later consisting of a series arranged biserially; wall arenaceous, varying much in coarseness in the different species; aperture variable as in the various species of *Textularia*, either an opening at the base of the inner margin of the chamber, between it and the wall of the preceding chamber, or a perforation near the base of the inner margin, often with a raised border, or in some species a terminal more or less circular opening.

This species, while related to *Textularia*, is by its development a genus derived through triserial forms, such as *Verneuilina*, and its resemblance to *Textularia* is due to a reversion in its later development to the biserial condition. There has been some attempt on the part of certain authors to split the genus on the basis of the apertural characters. While this seems reasonable, it is not followed out here, as already mentioned in connection with *Textularia*.

This genus has a considerable geological range, but after a study of certain forms it has not seemed wise to unite the recent species with the cretaceous ones described by d'Orbigny. The differences are great enough to be of good specific value, and a discussion of the characters involved will be found under the various species. Most of the recent species are rather constant in their characters, the variations being limited to unimportant details.

### GAUDRYINA SCABRA H. B. Brady.

*Gaudryina pupoides* H. B. Brady (not *G. pupoides* d'Orbigny 1840), Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 300, pl. 8, fig. 5.

*Gaudryina scabra* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 381, pl. 46, fig. 7.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 40.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 288, pl. 34, fig. 1.

*Description.*—Test elongate, gradually tapering to the initial end, which is broadly rounded; cross section rounded; early triserial portion composed of but few chambers, the later biserial portion forming the greater part of the test, chambers rotund; sutures distinct; wall coarsely arenaceous, but rather neatly cemented with a reddish-brown cement; aperture elongate, situated between the inner border of the chamber and the adjacent wall of the preceding chamber; color reddish brown, the last formed chamber often being light gray.

Length up to 2 mm.

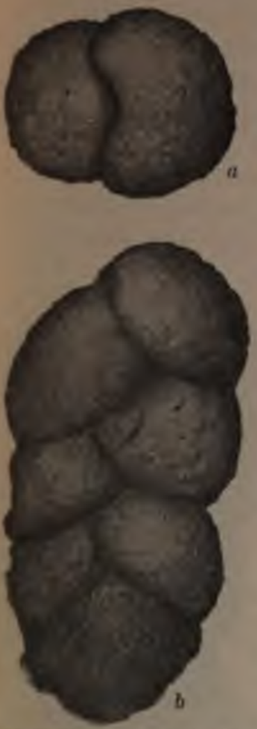


FIG. 100.—GAUDRYINA SCABRA. × 45. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

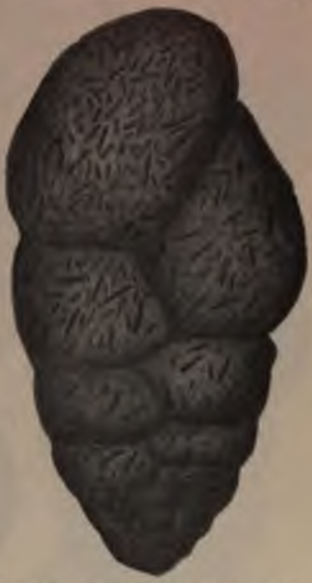


FIG. 101.—GAUDRYINA SCABRA. × 30 SPECIMEN WITH WALL CONTAINING SPONGE SPICULES.

*Distribution.*—The only published records for this species in the North Pacific are those given by Goës from off the west coast of America, *Albatross* stations D3419, in 772 fathoms, D3431, in 995 fathoms, and D3418, in 660 fathoms. I have examined the specimens of this species returned by Goës to the National Museum and they appear to be typical. In the further material I have examined the species has been noted but twice, from *Albatross* station H2922, in 268 fathoms, off the Hawaiian Islands and from *Tuscarora* station 126, in 500 fathoms, just south of the Aleutian Islands.

### GAUDRYINA FLINTII, new name.

*Gaudryina subrotundata* FLINT (not *G. subrotundata* Schwager, 1866), Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 287, pl. 33, fig. 1.

*Gaudryina rugosa* GOËS (not *G. rugosa* d'Orbigny, 1840), Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 39.

*Description.*—Test subcylindrical, gradually tapering to the initial end, the early triserial portion forming but a small part of the test, the later biserial portion making up fully three-fourths; chambers of the later portion well rounded, nearly circular in cross section; sutures well marked; wall arenaceous, usually rather coarse, but in some cases finer and more smoothly finished; aperture in the biserial portion a subcircular opening near, but somewhat away from, the in of the chamber; color gray.

Length 1–5 mm.

*Distribution.*—The specimens recorded by Flint and him as *G. subrotundata* Schwager were from the Atla specimens recorded by Goës from the eastern Pacific as d'Orbigny, prove upon examination to belong to this ne Specimens were also common in material from *Nero* stat 859 fathoms, off Guam.

It is possible that the *Challenger* specimens referred to *tundata* by Brady may also belong to this species, espec from the West Indies. The specimens recorded by Goës

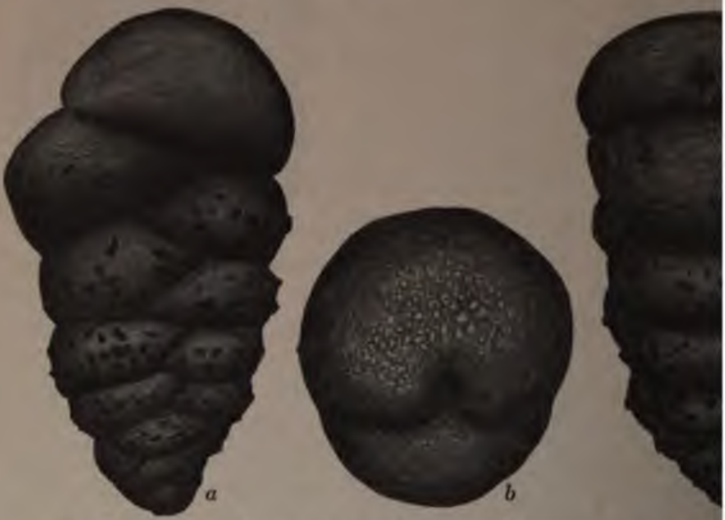


FIG. 102.—GAUDRYINA FLINTII. × 20. *a*, FRONT VIEW; *b*, APERTURAL VIEW; *c*, S

neither the *G. rugosa* of d'Orbigny nor the recent species *G. rugosa* by Brady. This species differs from *G. subro* the large size, more circular form in cross section, in t tapering form, and in having the aperture circular and in th

### GAUDRYINA QUADRANGULARIS Bagg.

*Gaudryina quadrangularis* BAGG, Proc. U. S. Nat. Mus., vol. 34, pl. 5, fig. 1.

*Description.*—Test elongate, tapering abruptly at the i composed of an early trihedral portion with acute angles a triserial group of chambers, and a later more or less qu portion composed of chambers biserially arranged; wal arenaceous and rather roughly cemented; aperture an orifice between the inner border of the chamber and th wall of the preceding chamber, with in end view a sort of rounded lip above and a depression at either side; in side view the aperture is in a depression of the abruptly truncated end of the test.

Length up to 3 mm.

*Distribution.*—The type-specimen (which I have examined) is from *Albatross* station D4000, in 104–213 fathoms, off the Hawaiian Islands. The only other specimens I have seen were obtained at *Nero* station 2071, in 271 fathoms, and *Albatross* station H2922, in 268 fathoms, also near the Hawaiian Islands.

The species is a large one, with a distinctly textularian aperture.

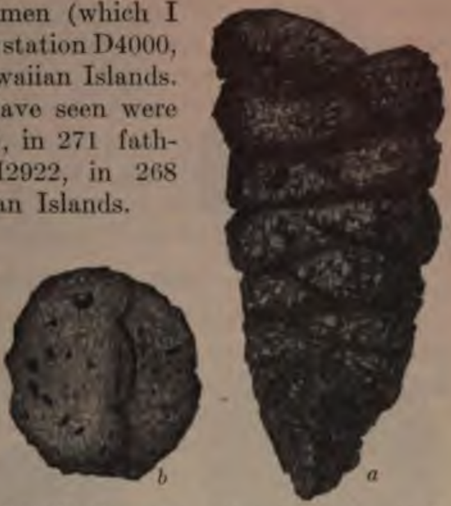


FIG. 103.—GAUDRYINA QUADRANGULARIS. × 30. *a*, FRONT VIEW; *b*, END VIEW.

### GAUDRYINA TRIANGULARIS, new species.

*Description.*—Test slightly longer than broad, for the most part triangular, the angles rather acute, composed of a series of chambers triserially arranged, the later chambers rotund, biserially arranged, few in number; walls coarsely arenaceous, more or less smoothly finished; sutures plainly visible on the exterior; aperture narrow, between the inner border of the chamber and the preceding chamber; color gray.

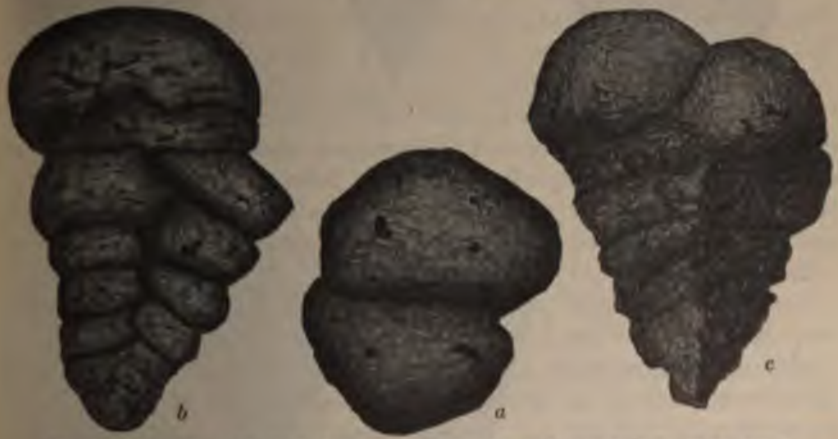


FIG. 104.—GAUDRYINA TRIANGULARIS. × 40. *a*, END VIEW; *b*, SIDE VIEW; *c*, FRONT VIEW.

Length about 1 mm.

*Distribution.*—Type-specimen from *Albatross* station H2922, in 268 fathoms, near the Hawaiian Islands (Cat. No. 8342, U.S.N.M.).

It occurred also at *Nero* station 1254, in 264 fathoms, near the Bonin Islands in the western Pacific.

This species may be the same as that from the Atlantic referred by various authors to *G. rugosa* d'Orbigny. A glance at the original figure given by d'Orbigny, however, shows the great difference between this recent species and d'Orbigny's cretaceous fossil species. In true *G. rugosa*, according to d'Orbigny's figure and description, the triangular portion is the smaller part, and the biserial portion the greater, the whole appearance of the test being very different. Here the triserial condition is maintained well toward the end of the test, where the biserial condition is taken on. Our recent species seems to me to have little in common with the cretaceous species.

### GAUDRYINA CONVEXA, new species.

*Description.*—Test triangular in front view, broad at the apertural and rather rapidly tapering to the initial end, one face nearly flat, the other strongly convex and with deeper sutures; apertural end obliquely truncate, in end view roughly semicircular; wall rather coarsely arenaceous; aperture elongate, between the inner border of the chamber and the adjacent wall of the preceding chamber, in distinct depression of the inner border of the chamber; color gray. Length 0.60 mm.

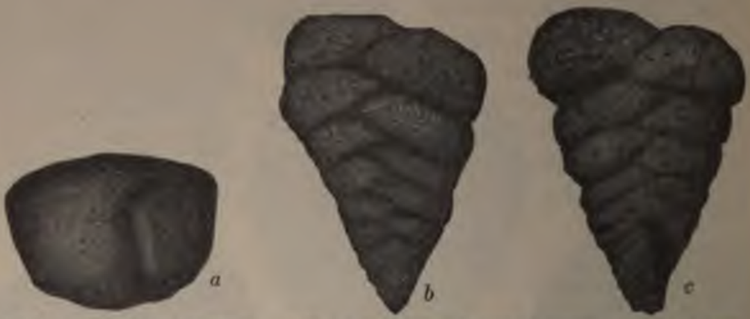


FIG. 105.—GAUDRYINA CONVEXA. × 60. *a*, END VIEW; *b*, DORSAL VIEW; *c*, VENTRAL VIEW.

*Distribution.*—Type from *Albatross* station D4878, in 59 fathoms eastern channel of the Korean Strait (Cat. No. 8343, U.S.N.M.).

This species suggests somewhat *G. wrightiana* Millett, but bot faces in our species in the biserial portion are convex, one of them however, only slightly so. It also somewhat resembles *G. jonesian* Wright.

### GAUDRYINA PAUPERCULA, new species.

*Description.*—Test short and broad, abruptly tapering to th broadly rounded initial end, the early portion triserial, the las developed chambers biserial; chambers inflated; sutures di tinct; end view broadly rounded; walls arenaceous, but with smooth exterior; aperture elongate, situated in a depression of the inner border of the chamber, between it and the adjacent wall of the preceding chamber; color gray or slightly brownish.

Length 2 mm.

*Distribution.*—This species was very abundant in material from *Albatross* station D4900, in 139 fathoms, Eastern Sea (type, Cat. No. 8340, U.S.N.M.).

This species seems at first glance to be very similar to *Verneuilina propinqua* H. B. Brady, but it is a *Gaudryina,* as the last formed chambers are decidedly biserial. It is a very short species and differs in general appearance from the others of its genus.

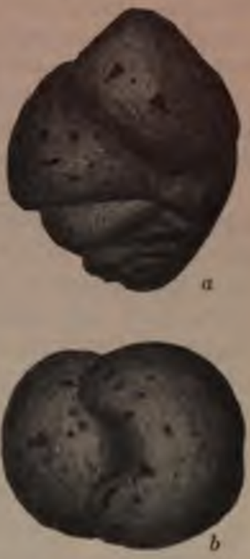


Fig. 106.—Gaudryina paupercula. × 15. *a,* front view; *b,* apertural view.

### GAUDRYINA BRADYI, new name.

*Gaudryina pupoides* H. B. Brady (not *G. pupoides* d'Orbigny), Rep. Voy. *Challenger,* Zoölogy, vol. 9, 1884, p. 378, pl. 46, figs. 1-4.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 219, pl. 43, figs. 7, 8.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 471.—Chapman, Proc. Zool. Soc. London, 1895, p. 20.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 40.—Flint, Ann. Rep. U.S. Nat. Mus., 1897 (1899), p. 287, pl. 32, fig. 4.

*Description.*—Test stout, somewhat elongate, tapering slightly until near the initial end where it tapers abruptly to the somewhat blunt end; triserial portion nearly circular in cross section, of few chambers, the later biserial portion making up about three-fourths of the test, slightly compressed; chambers overlapping and appearing crowded, broadly elliptical in cross section, inflated; sutures deep and distinct; end strongly convex; wall of fine arenaceous material or calcareous shell, smooth; aperture oval, slightly back from the inner margin of the chamber and with the border raised somewhat and thickened; color light gray.

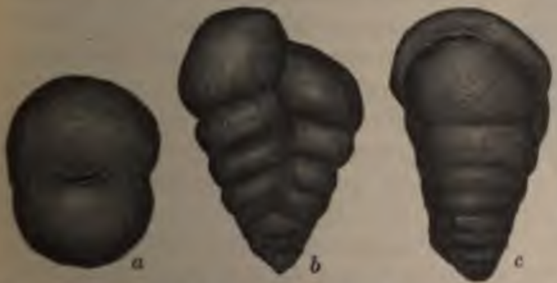


Fig. 107.—Gaudryina bradyi. × 25. *a,* end view; *b,* front view; *c,* side view.

Length 0.38 to 0.90 mm.

*Distribution.*—Under the name of *Gaudryina pupoides* this species has been recorded as follows from the North Pacific: Brady records it at two *Challenger* stations in 1,850 and 2,050 fathoms; Goës records it from two *Albatross* stations, D3375, in 1,201 fathoms, and D3376, in 1,132 fathoms; Bagg records it from four *Albatross* stations near the Hawaiian Islands, H4430, in 1,544 fathoms, H4555, in 1,398 fathoms, H4568, in 1,274 fathoms, and H4571, in 384 fathoms; Flint records it[a] from *Nero* station 613, in 1,072 fathoms.

In the material I have examined, the species has been frequently found in the vicinity of the Hawaiian and Galapagos Islands, Guam, off Japan, etc. The average depth of the stations is about 1,000 fathoms.

From an examination of the original figure and description given by d'Orbigny, it seems clear that our rather common recent form is not the same as his cretaceous species. Goës came to the conclusion that Brady's union of the two was incorrect. However, to unite both this species and *G. chilostoma* as Goës has done, both under the latter name, does not seem to me to be a solution of the matter, as the two seem to be very distinct. As no other name is available, a new name is here proposed. This is one of the cases where it would seem to have been better if Brady had proposed a new name instead of uniting different things, as the *Challenger* Report has been looked to so long as a standard that Brady's distinctions in regard to original figures and descriptions have not always been investigated by later authors. A new name at that time and a recognition of the existing differences would have cleared the synonymy greatly.

### GAUDRYINA BACCATA Schwager.

*Gaudryina baccata* SCHWAGER, *Novara* Exp., Geol. Theil, p. 2, 1866, p. 200, pl. 4, figs. 12*a*, *b*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 379, pl. 46, figs. 8-11.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 20.—FLINT, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 287, pl. 32, fig. 5.

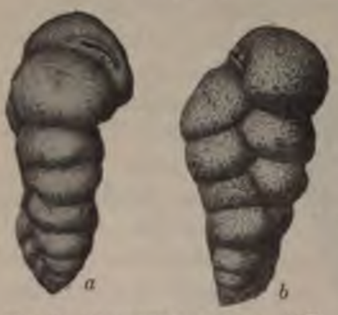


FIG. 108.—GAUDRYINA BACCATA. × 20. *a*, SIDE VIEW; *b*, FRONT VIEW (AFTER BRADY).

*Description.*—Test elongate, tapering gradually to the somewhat acute initial end; early portion composed of triserially arranged chambers with rounded angles and forming the lesser portion of the test; later portion biserial, often somewhat irregular; wall arenaceous, of fine material and smoothly finished; aperture elongate, somewhat back from the inner border of the chamber and often with a raised border; color gray.

Length about 2 mm.

*Distribution.*—The only records for this species in the North Pacific are the specimens recorded by Brady from *Challenger* station 206, in 2,100 fathoms, between China and the Philippines.

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[a] Bull. 55, U. S. Nat. Mus., 1905, p. 20.

This species is characterized by an irregular form in the biserial portion, one or more of the chambers breaking the alignment somewhat and causing the following to be less regular than they would be otherwise.

### GAUDRYINA CHILOSTOMA (Reuss).

*Textilaria chilostoma* Reuss, Zeitschr. deutsch. geol. Ges., vol. 4, 1852, p. 18.

*Gaudryina chilostoma* Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1866, p. 120, pl. 1, fig. 5.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 34, pl. 7, figs. 278–280; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 41.

*Gaudryina pupoides*, var. *chilostoma* H. B. Brady, Rep. Voy. *Challenger*, Zoölogy, vol. 9, 1884, p. 379, pl. 46, figs. 5, 6.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 219, pl. 42, fig. 9.

*Gaudryina pupoides*, var. *chilostomella* Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 278, pl. 7, fig. 6 [?].

*Description.*—Test compressed, broad, gradually tapering to the broadly rounded initial end; triserial portion consisting of but few chambers; biserial portion compressed, making up most of the test; chambers rounded; wall of fine arenaceous material; the surface smoothly finished; aperture an elongate slit slightly in from the inner edge of the chamber, surrounded by a slightly thickened and raised lip; color gray.

Length about 1 mm.

*Distribution.*—Goës records this species from *Albatross* station D3407, in 885 fathoms, off the Galapagos Islands. One at least of the two specimens selected by Goës from this station appears to be this species upon examination. Egger's figure and description are apparently meant for this species, but do not fit it very closely. I have seen but one specimen which I can refer to this species, from the coast of Japan, *Albatross* station D4916, in 361 fathoms.

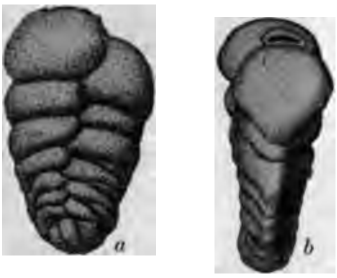

Fig. 109.—Gaudryina chilostoma. × 25. a, front view; b, side view (after Brady).

### GAUDRYINA APICULARIS, new name.

*Gaudryina siphonella* H. B. Brady (not *G. siphonella* Reuss, 1851), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 382, pl. 46, figs. 17–19.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 288, pl. 34, fig. 2.

*Description.*—Test elongate; triserial portion consisting of few chambers, forming usually somewhat less than half the test; later portion biserial, the chambers inflated and distinct, the later chambers with a forward extension, at the end of which is the aperture; wall rather coarsely arenaceous and slightly rough; aperture nearly circular, at the end of the elongate chamber; color reddish brown.

Length up to 1 mm.

*Distribution.*—As *G. siphonella*, Brady has recorded this from three *Challenger* stations in the North Pacific, in from 3,950 fathoms. I have noted the species but once, in 2,141 fa *Nero* station 1293, between Yokohama and G

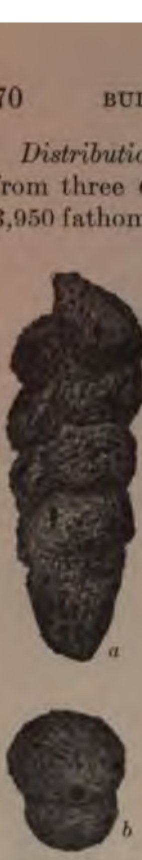
FIG. 110.—GAUDRYINA APICULARIS. × 60. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

An examination of the original descript *Gaudryina siphonella* Reuss,[a] and especially ures, shows that the recent species described very different from that fossil. Fig. 42 of shows a test with five vertical rows of cha and need not be further considered here. others, each has the final chamber very conv extending much higher on the outer side t any other part, and the aperture at the end of much lower projection. This curious form o both figs. 40 and 41 and is noted in the desc The recent species is very different, the ap portion forming the highest part of the chamber, which on its peripheral portion is lower than elsewhere, while the fossil species is highest there.

FIG. 1 DRYIN FILI × 60. VIEW VIEW, OUTI RIDGE THE A

**GAUDRYINA PSEUDOFILIFORMIS**, new name.

*Gaudryina filiformis* H. B. BRADY (not *G. filiformis* Berthelin), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 380, pl. 46, figs. 12*a–c*.

*Description.*—Test much elongate, composed of numerous chambers; early portion triserial with indistinct sutures; later portion, including nearly the entire test, biserial with the sutures deep and well marked; cross section elliptical, showing some compression; walls arenaceous, but usually smooth; aperture small, in adults back a little way from the inner margin of the chamber, slightly elongate, the edges thickened and raised to form a rim about it, appearing nearly tooth-like in end view; color gray.

Length 1 mm.

*Distribution.*—*G. filiformis* has been recorded from the North Pacific only once, by Bagg, at *Albatross* station H4568, in 1,274 fathoms, off the Hawaiian Islands. I have the species also from *Albatross* station H2 392 fathoms, off the same islands. These are the only reco the species in this area.

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[a] Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 78, pl. 5, figs. 40–42.

Although Brady referred the recent species to the cretaceous *G. filiformis*, it seems from a comparison of the material obtained with the original description and figure, that the two species are not the same, and the recent species is therefore differentiated under another name. It is smooth and has the aperture somewhat in from the edge, surrounded by a raised ridge.

## TRITAXILINA, new genus.

*Clavulina* (part) H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 54.
*Tritaxia* (part) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 390.

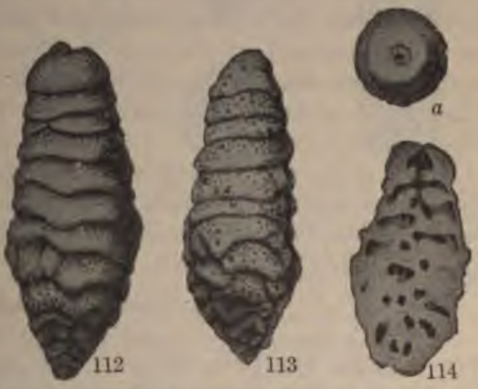
*Description.*—Test in the early portion triserial, later becoming biserial or uniserial; wall arenaceous; aperture in the adult, central and terminal, in the young like *Textularia* or *Verneuilina*, in adult condition with peripheral teeth projecting into the apertural opening; interior labyrinthic.

This genus includes a single species, *T. caperata* (H. B. Brady), which differs from the species of *Tritaxia* in the form of the test, the aperture, and the labyrinthic interior of the test.

### TRITAXILINA CAPERATA (H. B. Brady).

*Clavulina caperata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 54.
*Tritaxia caperata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 390, pl. 49, figs. 1–7.

*Description.*—Test fusiform, the early portion triserial, roughly triangular in cross section but with well rounded angles, the later portion becoming biserial or uniserial and circular in cross section; apical end rather acutely pointed; apertural end truncate or broadly rounded, chambers numerous; wall thick, composed of fine arenaceous material, in part traversed by long pore canals leading from the chamber to the exterior; interior of test labyrinthic; outer part of wall with a wrinkled appearance due to the thickening of the chamber wall just above the sutures; sutures distinct; aperture in the young like *Verneuilina*, in the adult becoming terminal and central with a peripheral border of inwardly projecting teeth; color gray.



Figs. 112-114.—Tritaxilina caperata; × 16. 112, *a*, apertural view. 114, specimen cut longitudinally, showing labyrinthic interior (after Brady).

Length up to 2.5 mm.

*Distribution.*—Brady records this species from but one North Pacific station, in 95 fathoms, near the Philippines. The other stations from which he records it are off Kandavu, Fiji, in 250 fathoms, and off Sombrero, West Indies, in 450 fathoms.

There are two specimens in the *Albatross* material from station D4781, in 482 fathoms, near the Aleutian Islands, which certainly seem to be this species. If this is the case the distribution is a very peculiar one. Except that the final stages are not entirely complete, the two specimens fit the figure and description excellently.

### Genus CLAVULINA d'Orbigny, 1826.

*Clavulina* D'ORBIGNY (type, *C. parisiensis* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 268.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 393.

*Verneuilina* (part) PARKER and JONES, Quart. Journ. Geol. Sci., vol. 16, 1860, p. 303.—BROECK, Ann. Soc. Belgique Micr., vol. 2, 1876, p. 136.

*Valvulina* (part) PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 35.

*Description.*—Test free, elongate, cylindrical, or angled; early portion consisting of a number of chambers arranged triserially; later portion consisting of numerous chambers arranged uniserially; walls arenaceous, usually smooth; aperture in early chambers with a valvular tooth; in the later portion aperture central or nearly so, rounded, and with or without a tooth.

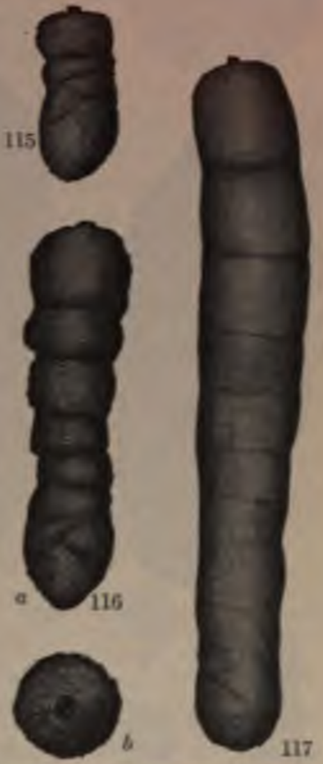
This genus includes those species of Textulariidæ which have a triserial early portion and the adult portion uniserial. Such species are clearly related to such forms as *Valvulina* and have added to the characters of that genus the uniserial condition. By acceleration of development the triserial stage has become very short in comparison

*Description.*—Test elongate, cylindrical, the early portion consisting of chambers arranged triserially, rounded in cross section; chambers almost indistinct from the exterior, the sutures not depressed; later portion consisting of chambers arranged uniserially, distinct, but the sutures only slightly excavated, circular in cross section; wall composed of sand, usually fine in texture, with the surface smoothly finished; aperture in the middle of the terminal wall of the chamber in the uniserial portion, usually with a short but very distinct neck; aperture with a single tooth; color gray.

Length up to 5 mm.

*Distribution.*—In the North Pacific this species was recorded by Brady from two *Challenger* stations, in 345 fathoms off Japan, and in 2,300 fathoms in the region east of Japan; Goës records it from several *Albatross* stations off the west coast of America in depths from 772–1,471 fathoms; Flint records it from 51 fathoms in Panama Bay. I have found it frequently in the North Pacific material which I have examined, most frequently in globigerina ooze and muds from a medium depth. It has occurred near the Galapagos Islands, and at scattered stations in the *Nero* material from the line of soundings across the Pacific, and in the material from the *Albatross* (1906) cruise it is common from about Japan. It occurs also in the collections from south of the Aleutian Islands, Tuscarora station 126, in 500 fathoms.

This, as far as the North Pacific is concerned, is by far the most common species. As shown by Brady's figures in the *Challenger* report, there are two rather different forms, but the material is not sufficient to establish definite varieties at this time.



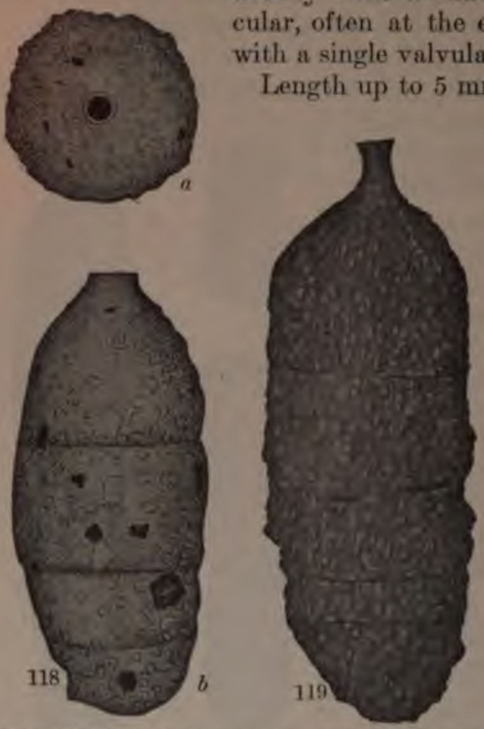
FIGS. 115-117.—CLAVULINA COMMUNIS. × 30. 115, YOUNG SPECIMEN WITH BUT TWO OF THE SECOND SERIES OF CHAMBERS DEVELOPED. 116, *a*, FRONT VIEW OF MEDIUM-SIZED SPECIMEN; *b*, END VIEW OF THE SAME. 117, ADULT SPECIMEN IN FRONT VIEW.

### CLAVULINA BRADYI, new name.

*Clavulina cylindrica* H. B. BRADY (not *C. cylindrica* d'Orbigny, 1826), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 396, pl. 48, figs. 32–38.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 134.

*Description.*—Test stout, cylindrical, the early triserial portion not well shown exteriorly, the later uniserial portion of few chambers, large, distinct, with well-defined, depressed sutures; wall arenaceous, composed of a mixture of coarse and fine material, but usually with a smooth exterior; aperture circular, often at the end of a short neck, usually with a single valvular tooth; color light gray.

Length up to 5 mm.



FIGS. 118-119.—CLAVULINA BRADYI. × 30. 118, *a*, END VIEW, WITHOUT TOOTH; *b*, FRONT VIEW OF TYPICAL SPECIMEN. 119, FRONT VIEW OF A PECULIARLY ROUGHENED SPECIMEN.

*Distribution.*—The only previously recorded station for this species is that given by Bagg: *Albatross* station D4000 in 104-213 fathoms, off the Hawaiian Islands. I have seen the species in material from *Nero* station 2037, in 55 fathoms, and 2071, in 271 fathoms, both in the vicinity of the Hawaiian Islands.

There is much exterior resemblance between this species and *Haplostiche dubia*, but the specimens of *Clavulina bradyi* having the single valvular tooth or sometimes none. Fig. 119 shows a specimen somewhat different from the usual form shown in fig. 118. It has a more distinctly roughened surface and a longer and more slender neck, but is associated with the species at the same station.

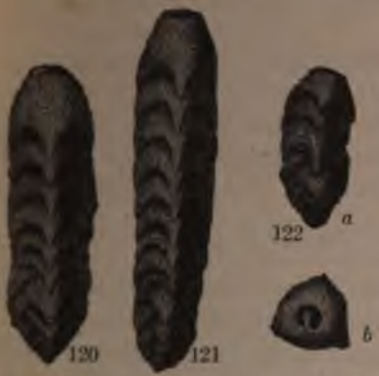
### CLAVULINA ANGULARIS d'Orbigny.

*Clavulina angularis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 268, pl. 12, fig. 7.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 396, pl. 48, figs. 22-24.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 37.—FLINT, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 289, pl. 36, fig. 2.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 13.—CHAPMAN, Journ. Linn. Soc., Zool., vol. 30, 1907, p. 29, pl. 4, figs. 68, 69 [70], [not 71-73].—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 133.

*Valvulina angularis* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 305.

*Valvulina triangularis* D'ORBIGNY, forma *clavulina* GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, p. 86, pl. 11, figs. 387-389.

*Description.*—Test elongate, triangular in cross section, the early triserial portion limited to a few chambers, followed by a few chambers biserial in character; finally the main portion of the test, which is uniserial, the chambers extending back along the angles of the test, arched upward across the faces, leaving a slight hollow below; wall arenaceous but smoothly finished on the exterior; aperture in the uniserial portion circular, in the middle of the apertural face, with a single valvular tooth.



120-122.—CLAVULINA ANGULARIS × 35. 122, *a*, FRONT VIEW; *b*, APERTURAL VIEW (AFTER BRADY).

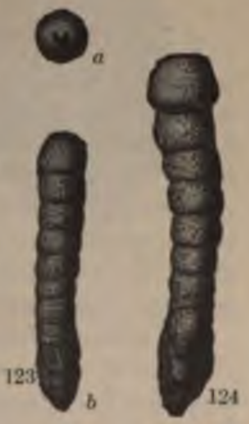
Length up to 1.25 mm.

*Distribution.*—There is but one record for this species in the North Pacific, that given by Bagg, from *Albatross* station D4017, in 305 fathoms, off the Hawaiian Islands. I have examined Bagg's specimen and it seems without doubt to be this species, although the test is not entire. It has been found in various parts of the other oceans, usually in rather shallow water.

### CLAVULINA PARISIENSIS d'Orbigny.

*Clavulina parisiensis* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 268; Modèles, 1826, No. 66.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 29, pl. 1, fig. 26.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 121, pl. 12 (20), figs. 34*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 395, pl. 48, figs. 14-18.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 220, pl. 42, figs. 10, 12.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1889, p. 485, pl. 11, fig. 11.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 274, pl. 6, fig. 44.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 41, pl. 8, figs. 378-386.—Chapman, Proc. Zool. Soc. London, 1895, p. 21.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 37.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 289, pl. 35, figs. 2, 3.

*Valvulina parisiensis* Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, pp. 29, 35, pl. 1, fig. 26.



Figs. 123-124.—Clavulina parisiensis. × 30. 123, *a*, apertural view; *b*, front view (after Brady).

*Description.*—Test elongate, slender, the early triserial portion decidedly angled, pyramidal, the upper end usually wider than the early part of the following uniserial portion which is cylindrical; chambers of this portion inflated, often well separated by deep sutures, sometimes moniliform; walls arenaceous, usually rather coarsely so, and the exterior more or less rough; aperture in the uniserial portion circular, central, partially closed with a broad valvular tooth.

Length up to 3 mm.

*Distribution.*—The only published records for this species from the North Pacific are those given by Brady from two *Challenger* stations, one off the Philippines, in 95 fathoms, the other in the deep water of the Pacific, in 3,125 fathoms. This latter seems all the more peculiar, as the species as a rule has been found in comparatively shallow water.

## Subfamily 4. BULIMININÆ.

Included in this subfamily are those forms which are typified by *Bulimina*. In typical species the arrangement of the chambers is an elongate spiral. The aperture is elongate, loop-shaped, usually in an oblique position, and in some species there is a tooth, flange, or other structure which partially closes the opening. The test is calcareous, often hyaline in the young, but may be considerably thickened and opaque in the adult; is always perforate.

Two new genera have been segregated from *Bulimina*, the differences in structure and development appearing to be worthy of more than specific rank.

### Genus BULIMINA d'Orbigny, 1826.

*Bulimina* D'ORBIGNY (type, *Bulimina marginata* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 269.—H. B BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 397.

*Description.*—Test usually fusiform or tapering, free, composed of

The groups of species which have numerous chambers in each coil and a definite umbilicus, with other accompanying characteristics, are grouped under the new genus *Buliminella*, and the single species *Bulimina williamsonii* H. B. Brady, which has the chambers hidden at the surface by the ornamentation, but nevertheless spiral, and the aperture central and terminal, has been made the type of the new genus *Buliminoides*.

There is a considerable range of species characters in the species of *Bulimina* as restricted, the chambers in certain forms becoming rapidly larger, and in the adult hiding the earlier or becoming larger with an accompanying extension of the axis of the spire forming a long tapering test with the triserial arrangement visible throughout.

From the difficulty of examining the proloculum and early chambers, little is known concerning the occurrence of the microspheric and megalospheric forms in the species of this genus.

### **BULIMINA OVATA d'Orbigny.**

*Bulimina ovata* D'ORBIGNY, For. Foss. Vienne, 1846, p. 185, pl. II, figs. 13, 14.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 400, pl. 50, figs. 13*a*, *b*.

*Description.*—Test ovate in front view, circular or nearly so in end view, the apex broadly rounded; visible chambers several, little inflated; sutures but slightly compressed; wall smooth; aperture rather narrow with a plate-like tooth; color white.

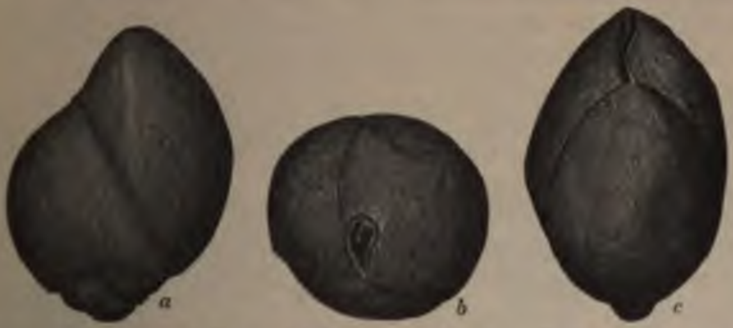


FIG. 125.—BULIMINA OVATA. × 40. *a*, FRONT VIEW; *b*, END VIEW; *c*, VIEW SHOWING APERTURE.

Length 0.75–1.20 mm.

*Distribution.*—Rather common throughout the area, except in very deep water.

The smooth species of *Bulimina* are in an extremely confused state, and as the material I have examined is insufficient to determine definitely the interrelationships of all the forms, they are referred to certain general species, usually taking the figures given by Brady as a broad basis for distinguishing the forms.

Brady's figure of *Bulimina ovata* is referred by Goës to *B. ellipsoides* Costa.

### BULIMINA PYRULA d'Orbigny.

*Bulimina pyrula* D'ORBIGNY, For. Foss. Vienne, 1846, p. 184, pl. 11, figs. 9, 10.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 399, pl. 50, figs. 7-10.

*Description.*—Test ovate in front view, broadest usually near the base, nearly circular in end view, the apex rounded; visible chambers few, very little inflated; sutures flush with the surface or very slightly depressed; wall smooth; aperture short and broad with a broad plate-like tooth partially closing the opening; color white.

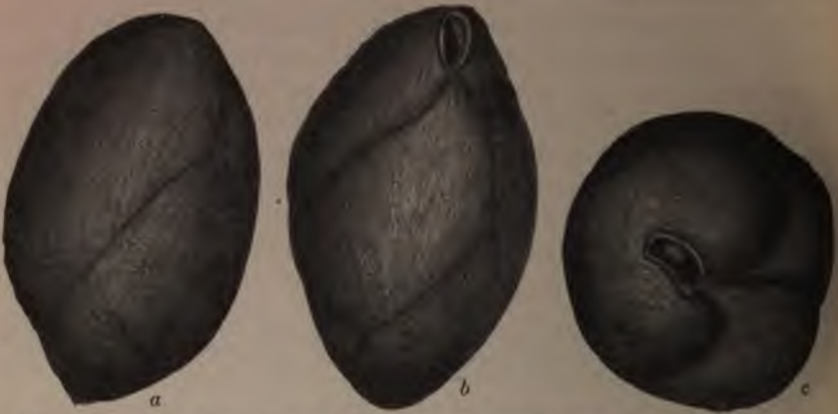


FIG. 126.—BULIMINA PYRULA. × 60. *a*, SIDE VIEW; *b*, VIEW SHOWING APERTURE; *c*, END VIEW.

Length 0.50–0.85 mm.

*Distribution.*—Strangely enough all the material which I have selected as belonging to this form has come from the coast of Japan, in from 134 to 437 fathoms.

This species has fewer visible chambers with a broader and shorter aperture than the preceding. The details of the aperture are shown in the enlarged figure.

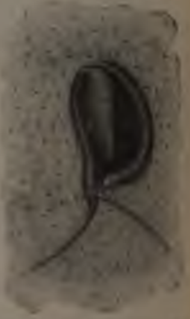


FIG. 127.—BULIMINA PY-RULA. × 75. DETAILS OF THE APERTURE.

### BULIMINA PYRULA d'Orbigny, var. SPINESCENS H. B. Brady.

*Bulimina pyrula* D'ORBIGNY, var. *spinescens* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 400, pl. 50, figs. 11, 12.

*Description.*—Similar to the typical form of the species but with the broad apical end of the test beset with short spines.

*Distribution.*—Specimens were found at *Albatross* station D4972, in 440 fathoms, off Japan. All have the same spinose apex.

The specimens figured here are much more elongate and of somewhat different form from those figured by Brady, but they have a similar spinose apex.

*Distribution.*—Bagg records this species from two *Albatross* stations, D4174 and D4025, in 275–865 fathoms, near the Hawaiian Islands. The only specimens I have seen were from near the Galapagos Islands, in 1,379 fathoms.

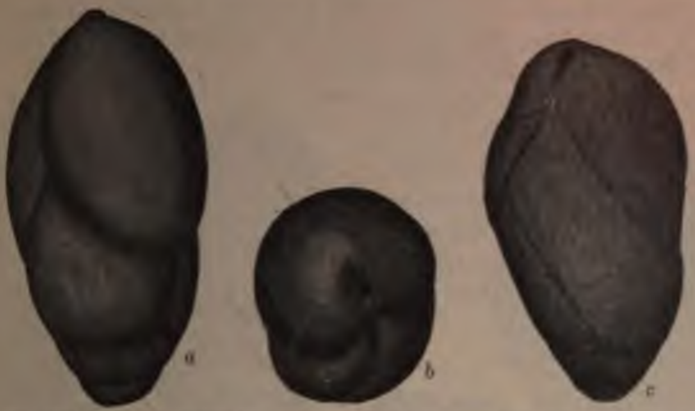


FIG. 132.—BULIMINA PUPOIDES. × 40. *a*, DORSAL VIEW; *b*, END VIEW; *c*, VENTRAL VIEW.

**BULIMINA TORTA, new species.**

*Description.*—Test elongate, broadest near the apertural end, tapering to the subacute apical end; apertural end broadly rounded; early portion slightly compressed; later portion circular in cross section; chambers several, somewhat inflated; sutures depressed; wall calcareous, perforate, smooth; aperture very long and narrow, curved, broadest at the upper end; color white.

Length 0.65 mm.

*Type-specimen.*—Cat. No. 8341, U.S.N.M., from *Albatross* station H2902, in 1,783 fathoms, northeast of the Hawaiian Islands.

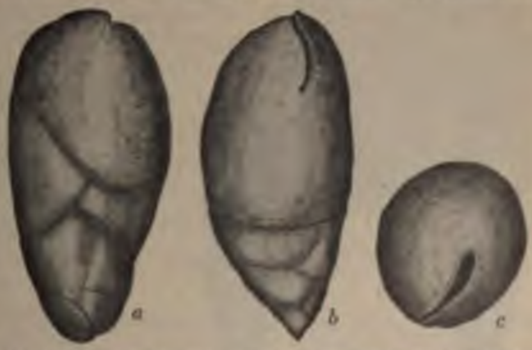


FIG. 133.—BULIMINA TORTA. × 60. *a*, DORSAL VIEW; *b*, VENTRAL VIEW; *c*, END VIEW.

The aperture of this species is very elongate, with no apertural tooth present in this specimen. The chambers in dorsal view have an irregular arrangement, becoming regularly placed in ventral view.

### BULIMINA ELEGANS d'Orbigny.

*Bulimina elegans* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 270, No. 10; Modèles, 1826, No. 9.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 20, pl. 2, fig. 64.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 398, pl. 50, figs. 1-4.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 284, pl. 8, figs. 66, 67.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 290, pl. 36, fig. 3.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 274, pl. 2, fig. 1.

*Description.*—Test elongate, conical, tapering to the acutely pointed, sometimes mucronate, apical end; chambers numerous, inflated; sutures deeply depressed; wall calcareous, smooth; aperture short, broad, and rounded; color, white.

Length 0.50–0.85 mm.

*Distribution.*—The species has not previously been recorded from the North Pacific. The specimens I have examined were from various stations off the coast of Japan, in 282–584 fathoms, and from Bering Sea, in 536 fathoms.

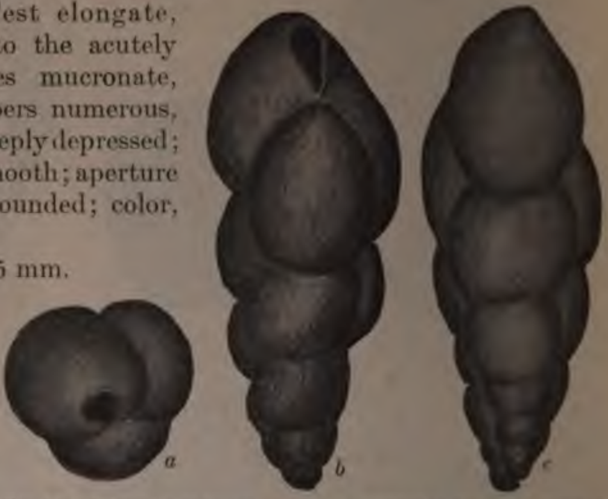


FIG. 134.—BULIMINA ELEGANS. × 60. *a*, APERTURAL VIEW; *b*, VENTRAL VIEW; *c*, DORSAL VIEW.

### BULIMINA ELEGANS d'Orbigny, var. EXILIS H. B. Brady.

*Bulimina elegans* D'ORBIGNY, var. *exilis* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 399, pl. 50, figs. 5, 6.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 275.—SIDEBOTTOM, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 12, pl. 1, fig. 11.

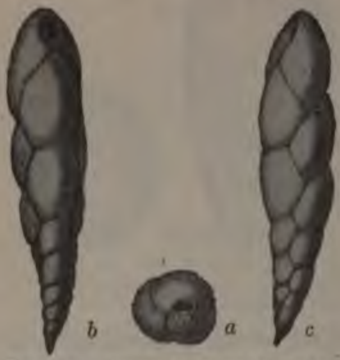


FIG. 135.—BULIMINA ELEGANS, VAR. EXILIS. × 60. *a*, APERTURAL VIEW; *b*, SIDE VIEW; *c*, FRONT VIEW (AFTER BRADY).

*Description.*—"Test much elongated, slender, tapering, more or less compressed on three sides; oral end subacute or rounded, aboral extremity acuminate. Segments numerous, oblique, somewhat inflated, arranged in a regular triserial spire."

Length 0.75 mm.

*Distribution.*—Brady records this variety from the North Pacific at *Challenger* station 232, in 345 fathoms, on the *Hyalonema*-

ground south of Japan. I have not found any specimen sufficiently elongated to warrant their being placed in this variety. The figure and description are from Brady.

### BULIMINA MARGINATA d'Orbigny.

*Bulimina marginata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 269, No. 4, pl. 12, figs. 10–12.—PARKER and JONES, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 296, pl. 11, figs. 35–40.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 405, pl. 51, figs. 3–5.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc., vol. 12, 1888, p. 220, pl. 43, figs. 7, 10.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 474.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 287, pl. 8, figs. 69, 70.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 46, pl. 9, figs. 439–444.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 277.

*Bulimina pupoides*, var. *marginata* WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 62, pl. 5, figs. 126, 127.

*Bulimina presli*, var. *marginata* PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 372, pl. 15, fig. 10; pl. 17, fig. 70.

*Description.*—Test ovate or tapering; chambers numerous, inflated, all visible from the exterior; sutures deep; lower margins of the chambers extending back with a free edge which is serrate, or may be only crenulate, or even spinose; remaining portion of chamber smooth and unornamented; wall thin and transparent, or in older specimens thickened, white, and nearly opaque; aperture a comma-shaped slit in a slight depression of the inner face of the chamber, with a slightly raised border.

Length usually under 1 mm., but some specimens slightly larger.

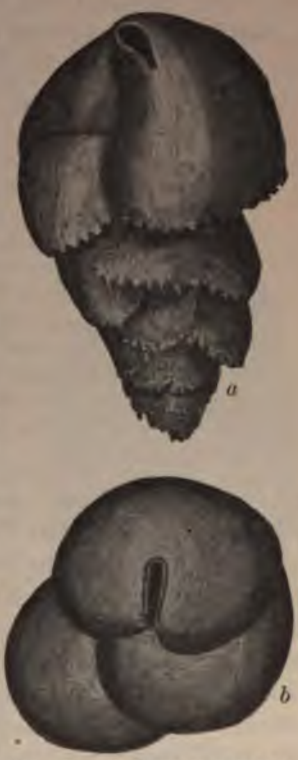


FIG. 136.—BULIMINA MARGINATA. × 150. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

*Distribution.*—This species has been recorded once from the North Pacific. It occurred at *Challenger* station 232 on the *Hyalonema*-ground south of Japan, in 345 fathoms. In the present collection I have seen specimens from two *Albatross* stations off Japan, D4972, in 440 fathoms, and D5056, in 258 fathoms. Specimens were also found in the *Nero* material from three stations near the Bonin Islands, south from Japan, in 1,208–1,760 fathoms. All the records for this species in the North Pacific are therefore from the faunal region of Japan, and adjacent waters. The recorded distribution of the species elsewhere is very wide, both as to geographical and bathymetrical range.

The species may be confused on one hand with *Bulimina inflata*, which, however, has ribs running up on the face of the chambers, these in *B. marginata* being smooth, and with *B. aculeata* on the other hand, which has long spines over the chamber wall on the early chambers, in adult specimens the last formed chambers being smooth. In *B. marginata* the lower margins of all chambers are serrate with little difference in the earlier and later formed in this respect.

### BULIMINA INFLATA Seguenza.

*Bulimina inflata* Seguenza, Atti Accad. Gicenia Sci. Nat., ser. 2, vol. 18, 1862, p. 109, pl. 1, fig. 10.—Schwager, *Novara* Exped. geol. Theil, vol. 2, 1866, p. 246, pl. 7, fig. 91.—H. B. Brady, Rep. Voy. *Challenger*, Zoölogy, vol. 9, 1884, p. 406, pl. 51, figs. 10–13.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 220, pl. 43, fig. 9.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 474.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 288, pl. 8, fig 85.—Chapman, Proc. Zool. Soc. London, 1895, p. 22.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 46.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 291, pl. 37, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1899, p. 279.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 135.

*Description.*—Test short, ovate, composed of overlapping chambers, triserial, the sutures deep; edge of chamber extending out into a free winglike expansion with a crenulated border extending outward into short spines, from which raised costæ extend back into the outer surface of the chambers; upper portions of the chambers smooth and unornamented; wall transparent and thin in the young, becoming thickened and white in the adult; aperture an obliquely placed slit, elongated, widest near the upper end, usually with a raised border, and often with a lip extending in on the concave side.

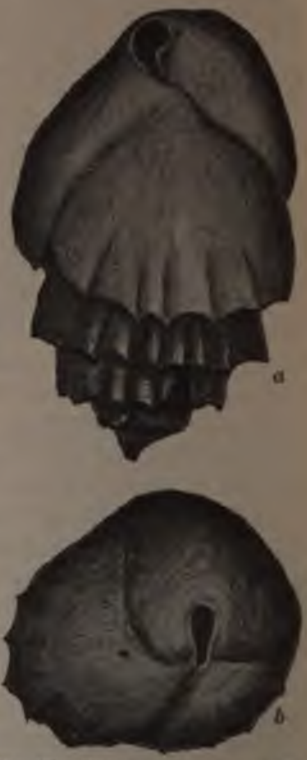


Fig. 137.—Bulimina inflata. × 60. *a*, front view; *b*, apertural view.

Length, 0.4–1.0 mm.

*Distribution.*—This species seems to be widely distributed in the North Pacific. It was recorded by Brady from *Challenger* station 209, in 95 fathoms, near the Philippine Islands. Goës records it from two *Albatross* stations in the eastern part of the tropical Pacific, in 695 and 995 fathoms. Bagg found it in material from four *Albatross* stations near the Hawaiian Islands, in 384–1,307 fathoms. In my own work I have found specimens from a large number of stations, especially in the Western Pacific about Japan, and southward, and also in the deeper water in various places. It has occurred also in material from between Hawaii and the western coast of America. Of these various stations the shallowest at which I have found the species is 181 fathoms, and the deepest 1,417 fathoms.

The species, although widely distributed, has not been met with in any considerable numbers at any one station.

Brady speaks of this species as a transition form connecting *Bulimina aculeata* and *B. buchiana*, but it has always been easily distinguished from either of these two species in the material I have examined. In a large list of stations the two species *B. inflata* and *B. buchiana* occurred at the same station but twice.

As far as the North Pacific is concerned *Bulimina inflata* seems to be the most common species of the genus.

### BULIMINA BUCHIANA d'Orbigny.

*Bulimina buchiana* D'ORBIGNY, For. Foss. Vienne, 1846, p. 186, pl. 11, figs. 15–18.—REUSS, Sitz. kais. Akad. Wiss. Wien, vol. 55, 1867, p. 95, pl. 4, figs. 10*a*, *b*.—TERRIGI, Atti Acc. Pont. Nuovi Lincei, vol. 33, 1880, p. 195, pl. 2, fig. 37.—H. B. BRADY, Rep. Voy. *Challenger*, Zoölogy, vol. 9, 1884, p. 407, pl. 51, figs. 18, 19.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 474.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 286, pl. 8, figs. 68, 77.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 22.—BAGG, Bull. U. S. Nat. Mus., vol. 34, 1908, p. 135.

*Bulimina presli*, var. *buchiana* PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 374, pl. 17, fig. 71.

*Bolivina karreriana* BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 138 (not *B. karreriana* H. B. Brady).

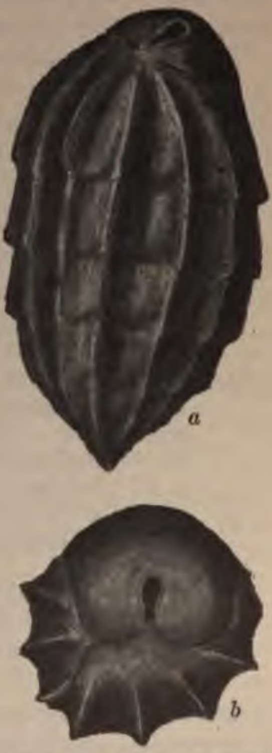


FIG. 138.—BULIMINA BUCHIANA. × 150. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

*Description.*—Test ovate, short, composed of numerous inflated chambers; sutures fairly deep, triserial; chambers visible from base to apex; ornamentation consisting of a series of raised costæ, usually three to five on each chamber, and becoming confluent with those on the chambers directly above and below, so that the test has the appearance of bearing longitudinal costæ from the early chambers to the basal portion of those last formed; wall thin and transparent in young specimens, in adults becoming thickened, white, and opaque, perforate; final series of chambers smooth above; aperture a looplike opening on the inner margin of the chamber.

Length, 0.3–0.8 mm.

*Distribution.*—The only previous records for this species in the North Pacific are those of Bagg from near the Hawaiian Islands, at *Albatross* stations H4568, in 1,274 fathoms, and H4585, in 689 fathoms. His selected specimens appear to be typical. Brady did not find the species in the *Challenger* material from the North Pacific. In the *Albatross* and *Nero* material that I have examined this species has occurred at numerous stations. These are for the most part in the western portion of the area. As a rule the depths at which this species has been taken correspond well with the observations of Brady on the *Challenger* material. All of our stations come within the range given by Brady. The shallowest occurrence of the species in this material is 440 fathoms and the deepest 2,086 fathoms. The great majority of the stations are in water between 1,000 and 2,000 fathoms in depth.

The figured specimen is not an adult, the costæ on all but the last-formed chamber reaching well up toward the upper end, while in the adult, as a rule, the three chambers last formed are comparatively smooth. The overlapping appearance is seen in profile at the sides.

An examination of Bagg's specimen recorded as *Bolivina karreriana* shows it to be a young specimen of *Bulimina buchiana*.

### BULIMINA ACULEATA d'Orbigny.

*Polymorpha pineiformis* Soldani, Testaceographia, vol. 1, pt. 2, 1791, p. 118, *Distribution.*—This species is very widely distributed in the various ocean basins. In the North Pacific it is recorded by Brady from one *Challenger* station, 232, in 345 fathoms, on the *Hyalonema*-ground south of Japan. Bagg records it from a single *Albatross* station, H4567, in 1,307 fathoms, near the Hawaiian Islands. Goës did not note the species in the eastern Pacific material examined by him, and I have failed to find it in material from the same region. Just east of the Hawaiian Islands it has been noted in material from a few stations, in 1,424–2,615 fathoms. I have found it also at one station just off the Hawaiian Islands, in 392 fathoms. It has occurred at a great number of stations in the Western Pacific, about Japan and in the region to the south. The depth of the stations at which it was taken range from 76 to 1,299 fathoms, with the average depth between 500 and 1,000 fathoms.

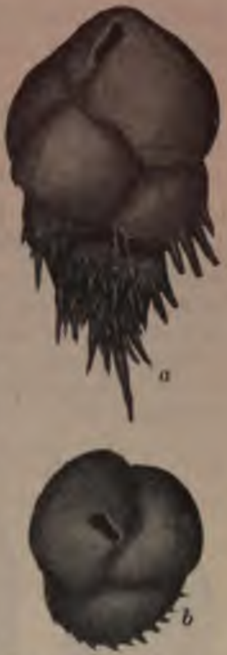


FIG. 139.—BULIMINA ACULEATA. × 75. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

From a study of the various figures of specimens assigned to this species it would seem as though there were two or more distinct forms confused under this name. The most common and typical form seems to be that figured here and in the *Challenger* report on plate 51, fig. 8. In the North Pacific this is the common form.

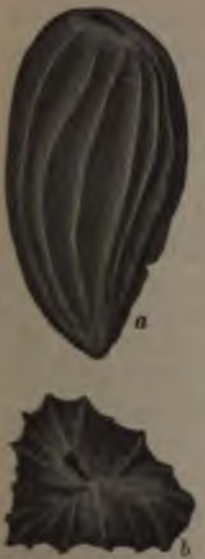


FIG. 140.—BULIMINA ROSTRATA. × 150. *a*, FRONT VIEW; *b*, APERTURAL VIEW.

### BULIMINA ROSTRATA H. B. Brady.

*Bulimina rostrata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 408, pl. 51, figs. 14, 15.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 287, pl. 8, figs. 96, 97.

*Description.*—Test ovoid, tapering to an acute point, sometimes with a distinct apical spine; chambers arranged triserially, but indistinct in front view; surface with a series of raised costæ running from the apical end to the last-formed whorl, concealing the sutures; end view showing the sutures; wall punctate, opaque, white; aperture elongate, comma-shaped.

Length 0.3–0.5 mm.

*Distribution.*—Brady found this species in material from four *Challenger* stations in rather deep water in the South Atlantic and

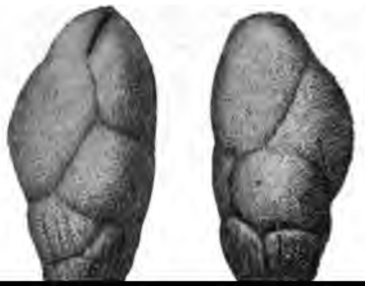
Southern Ocean, between the Cape of Good Hope and Kerguelen Island, and off the Ki Islands. Egger in the *Gazelle* report records it once from West Australia; but his figures do not indicate typical specimens. It has not previously been recorded from the North Pacific. I have specimens of this species from six stations widely scattered in this area, as follows: *Albatross* station H2899, in 1,531 fathoms, near the Hawaiian Islands; *Nero* stations 170, east of Midway Island, in 1,990 fathoms; 1123, 1185, and 1208, near the Bonin Islands, in the Western Pacific in 1,877, 1,491, and 665 fathoms, respectively; and *Albatross* station D4957, in 437 fathoms, off Japan.

This seems to be a small species, distinct from *Bulimina buchiana*, with continuous costæ of sufficient strength to obscure the sutures of the test.

### BULIMINA SUBORNATA H. B. Brady.

*Bulimina subornata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 402, pl. 51, figs. 6*a*, *b*.

*Description.*—"Test oblong-ovate; resembling that of *Bulimina pupoides* in general form and segmentation; the earlier chambers ornamented externally with raised longitudinal costæ; the aboral extremity generally armed with a stout spine. Shell-wall conspicuously ornamented."



Length 0.5 mm.

*Distribution.*—This species was described by Brady from material dredged by the *Challenger* on the

This genus contains species such as *Buliminella elegantissima* (d'Orbigny), where the spiral form of the test is very marked, and others which show a lesser tendency toward the spire, such as *Buliminella subteres* (H. B. Brady), *B. declivis* (Reuss) and *B. contraria* (Reuss). It is very different from typical *Bulimina*, with its simple triserial arrangement of the chambers.

*Type-species.—Buliminella elegantissima* (d'Orbigny).

### BULIMINELLA SUBTERES (H. B. Brady).

*Bulimina presli*, var. *elegantissima* Parker and Jones, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 374, pl. 15, figs. 12–17.

*Bulimina elegantissima* (var.) H. B. Brady, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 436, pl. 21, fig. 12.

*Bulimina subteres* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 55.—Wright, Proc. Belfast Nat. Field Club, 1880–81, App. p. 180, pl. 8, figs 2, 2*a*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 403, pl. 50, figs. 17, 18.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 289, pl. 8, figs. 73, 74.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 46, pl. 9, figs. 445–453.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 49, No. 5, 1905, p. 10.

*Description.*—"Test elongate-ovate, tapering to a blunt point at the initial extremity, rounded at the distal end; consisting of from two to three more or less regular, oblique convolutions. Chambers relatively large and only slightly ventricose externally; sutural lines very distinct. Aperture a curved slit near the inferior umbilical margin of the terminal chamber, considerably removed from the distal end of the test."

Length 0.4–0.6 mm.

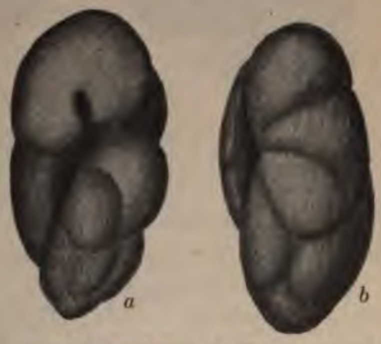


Fig. 142. Buliminella subteres. × 80. *a*, apertural view; *b*, side view.

*Distribution.*—A single specimen of this species was found in material from *Nero* station 1254, in 264 fathoms, south of Japan. It appears to be the only record for this region, although Brady records it from eight stations in the South Pacific.

The *Nero* specimen matched exactly the figure given by Brady and reproduced here. The description is from Brady.

### BULIMINELLA CONTRARIA (Reuss).

*Rotalina contraria* Reuss, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 76, pl. 5, fig. 37.

*Bulimina contraria* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 409, pl. 54, fig. 18*a*, *b*, *c*.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 288, pl. 8, figs. 81, 82.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 135.

*Cassidulina jonesiana* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 59.

*Description.*—Test coiled in a depressed spire, umbilicate, the chambers numerous, slightly inflated; sutures distinct, slightly depressed;

wall smooth, calcareous; aperture distinctly bulimine, loop-like, rather long and narrow, extending to the umbilicus; color white.

Diameter about 0.75 mm.

*Distribution.*—Recorded by Brady from the *Hyalonema*-ground, south of Japan, in 345 fathoms, and by Bagg from three *Albatross* stations near the Hawaiian Islands, D4000, H4430, and H4555, in 104–1,544 fathoms.

This is a rather anomalous species, but seems to be related to the other species of the *Bulimina* group by its aperture, and to *Buliminella* by its spirally coiled form.

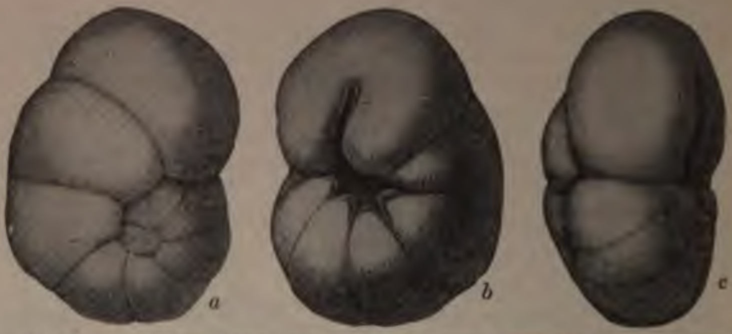


FIG. 143.—BULIMINELLA CONTRARIA. × 60. *a*, DORSAL VIEW; *b*, VENTRAL VIEW; *c*, PERIPHERAL VIEW (AFTER BRADY).

## BULIMINOIDES, new genus.

*Description.*—Test triserial, spiral, elongate, subcylindrical; wall calcareous, perforate; aperture nearly circular, terminal, in a depression of the truncated apertural end.

This genus differs from true *Bulimina* in its spiral cylindrical form and its central, circular, terminal aperture. It contains but one species, *B. williamsoniana* (H. B. Brady).

*Type-species.*—*Buliminoides williamsoniana* (H. B. Brady).

### BULIMINOIDES WILLIAMSONIANA (H. B. Brady).

*Bulimina williamsoniana* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 56; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 408, pl. 51, figs. 16, 17.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 279, pl. 2, fig. 8.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 136.

*Description.*—Test subcylindrical, elongate, spirally twisted, triserial, slightly tapering, the apical end broadly rounded, the apertural end obliquely truncated, depressed; chambers numerous, long and narrow, obliquely placed; sutures not clearly marked, being hidden by the surface ornamentation; wall calcareous, perforate, ornamented with a series of longitudinal costæ, somewhat twisted, following over the apertural end and continuing to the edge of the aperture, occasionally bifurcating; aperture terminal, central, circular, situated in the center of the depression at the apertural end; color, white.

Length 0.50–0.80 mm.

*Distribution.*—The only North Pacific record for this species is given by Bagg, *Albatross* station H4694, in 865 fathoms, off the Hawaiian Islands. I have had material from *Albatross* station H2922 in 268 fathoms, also off the Hawaiian Islands.

The species seems to be a tropical or subtropical one, being found in the area from northern Australia through the South Pacific and Malay Islands, a not uncommon distribution for other species found in the Hawaiian waters.

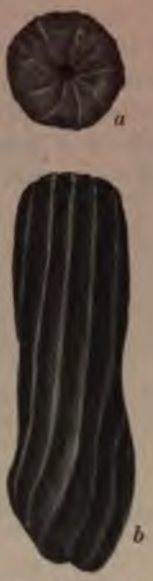


FIG. 144.—BULIMINOIDES WILLIAMSONIANA. × 60. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

### Genus VIRGULINA d'Orbigny, 1826.

*Virgulina* D'ORBIGNY (type, *V. squamosa* d'Orbigny). Ann. Sci. Nat., vol. 7, 1826, p. 267.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 413.

*Bulimina* (part) BAILEY, Smiths. Contr. Knowledge, vol. 2, 1851, p. 12.—PARKER and JONES, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 296; Philos. Trans. Roy Soc., vol. 155, 1865, p. 375.—WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 63.

*Description.*—Test elongate, made up of chambers from one side biserial, from the other more or less spiral or irregular; wall calcareous, perforate; aperture large, comma-shaped, on the inner portion of the chamber; color, white.

This genus, including but a few species, has a wide distribution in the present seas and is found fossil especially in the later tertiary. On the one hand it is related to *Bulimina*, and on the other hand many of its characters are not unlike *Bolivina*, especially the aperture.

#### VIRGULINA SQUAMOSA d'Orbigny.

*Virgulina squamosa* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 267; Modèles, No. 64.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 29, pl. 2, fig. 66; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 415.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 291, pl. 8, figs. 98, 104.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, pt. 9, 1894, p. 47, pl. 9, figs. 454, 456, 460; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 46.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 13, pl. 3, fig. 5.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 136.

*Description.*—Test elongate, tapering, the chambers oblique, longer than wide; test becoming much wider toward the apertural end, thin;

walls calcareous, smooth, and polished; sutures clearly marked, but not deep; aperture elongate, narrow, comma-shaped; color, white.

Length about 0.50 mm.

*Distribution.*—This species is well distributed over the North Pacific in water of medium depths, few stations being less than a thousand fathoms.

There is some confusion as to the application of d'Orbigny's name, but it is here applied to the rather thin, broad, tapering form with oblique chambers, such as is shown by d'Orbigny's model. With such an application it may be rather easily distinguished from the more rotund, less tapering *V. subsquamosa* Egger.

### VIRGULINA SUBSQUAMOSA Egger.

*Virgulina subsquamosa* Egger, Neues Jahrb., 1857, p. 295, pl. 12, figs. 19-21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 415, pl. 52, figs. 9-11.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 291, pl. 8, figs. 89, 90, 109.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, pt. 9, 1894, p. 49, pl. 9, figs. 473-474; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 46.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 291, pl. 37, fig. 7.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 13.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 136.

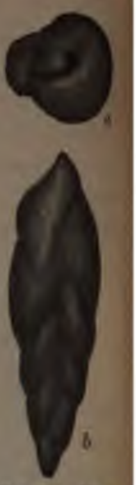


FIG. 145.—VIRGULINA SQUAMOSA, MODIFIED FROM THE ORIGINAL. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

*Description.*—Test elongate, tapering, the chambers somewhat oblique, with slightly depressed sutures, slightly inflated in the narrower forms; test in side view somewhat curved; walls calcareous, smooth and polished; aperture elongate, fairly broad, comma-shaped; color, white.

Length 0.40-0.65 mm.

*Distribution.*—This species has been recorded by Brady, Goës, and Bagg from the North Pacific; from the *Hyalonema*-ground, 345 fathoms, off Japan by Brady; from the eastern Pacific in 1,132 fathoms by Goës; and from about the Hawaiian Islands by Bagg, in 275-1,544 fathoms. I have found specimens referable to this species from many stations well scattered over the North Pacific.

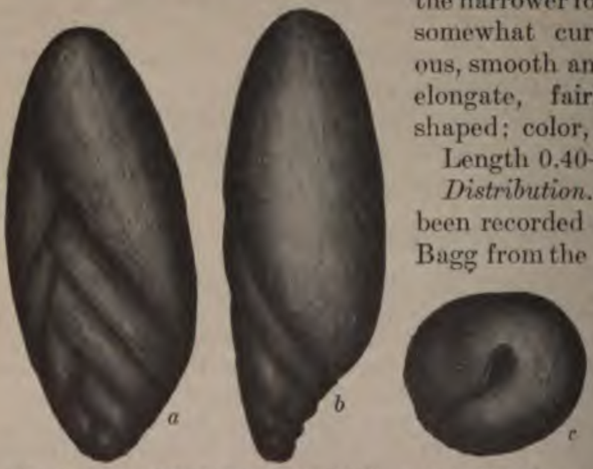


FIG. 146.—VIRGULINA SUBSQUAMOSA. × 120. *a*, FRONT VIEW; *b*, SIDE VIEW; *c*, APERTURAL VIEW.

That there is a decided confusion in regard to this and the foregoing species is evident from a study of the original descriptions and figures and a comparison with later figures. The originals are much closer than later authors have made their diagnoses of the two, and it is now difficult, without a large series of specimens, to determine clearly the limits of the species as they exist at present. Unfortunately, although the material studied from the North Pacific is from many stations, the number of specimens from any one station is too small to admit of a comparative study of variation. A large series would probably show that there are definite species with more or less clearly defined distribution, as has been elsewhere found to be the case when conditions were favorable for such a study.

### VIRGULINA SUBSQUAMOSA Egger, var. STRIATA Bagg.

*Virgulina squamosa striata* BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 137, pl. 5, fig. 7.

*Description.*—Test elongate, slightly tapering, bluntly rounded at the apical end, obliquely truncate at the apertural end; the chambers about as broad as high, somewhat rotund; the sutures distinct; wall calcareous, polished, ornamented with longitudinal costæ; color, white.

Length about 0.50 mm.

*Distribution.*—Described from *Albatross* station D4025, in 275–368 fathoms, near the Hawaiian Islands.

A study of the type specimen seems to place the species rather as related to *V. subsquamosa* Egger rather than to *V. squamosa* d'Orbigny as here considered. It may be a good species, but further material is desirable for study before this can be determined.

### VIRGULINA SUBDEPRESSA H. B. Brady.

*Virgulina subdepressa* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 416, pl. 52, figs. 14–17.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 291, pl. 8, fig. 103.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 47.

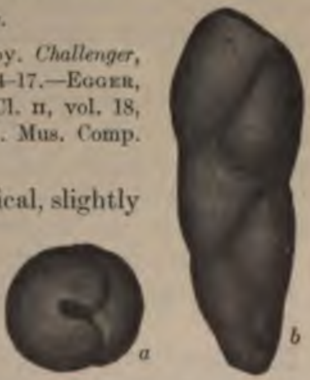


FIG. 147.—VIRGULINA SUBDEPRESSA. × 50. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

*Description.*—Test elongate, subcylindrical, slightly compressed; the chambers fully as high as broad, inflated, the sutures deep; outline distinctly crenulate; apical end of test broadly rounded; wall calcareous, smooth and polished; aperture fairly broad, comma-shaped; color, white.

Length about 1 mm.

*Distribution.*—Goës records this species from a single station off the western coast of America, in 730 fathoms. I have seen material from four stations, *Albatross* station

H4856, 898 fathoms, Bering Sea, *Nero* station 170 in 1,990 fathoms near Midway Island, and *Nero* stations 1128 and 1123 in 1,418 and 2,049 fathoms in the Western Pacific.

From the material examined the characters of this species seem to be well defined. It is more cylindrical in form than any of the other recent species, and its shape, with the triangular outline of the inflated chambers, distinguishes it from the other species.

The original stations given by Brady are all in deep water, as are also the *Gazelle* stations, from which the species is recorded by Egger.

### VIRGULINA SCHREIBERSIANA Czjzek.

*Virgulina schreibersiana* Czjzek, Haidinger's Nat. Abhandl., vol. 2, 1848, p. 147, pl. 13, figs. 18–21.—Egger, Neues Jahrb., 1857, p. 295, pl. 12, figs. 12–14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 414, pl. 52, figs. 1–3.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 290, pl. 8, figs. 93, 95.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 48, pl. 9, figs. 459, 461–472.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 291, pl. 37, fig. 6.—Fornasini, Mem. Accad. Sci. Instit. Bologna, ser. 5, vol. 7, 1898, p. 206, pl., fig. 6.—Millett, Journ. Roy. Micr. Soc., 1900, p. 280, pl. 2, fig. 13.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 13, pl. 3, fig. 4.

*Bulimina presli*, var. (*Virgulina*) *schreibersii* Parker and Jones, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 375, pl. 15, fig. 18; pl. 17, figs. 72, 73.

*Description.*—Test much elongated, narrow, tapering, compressed, slightly curved in side view, the apical end tapering to a blunt point; the chambers much longer

### VIRGULINA TEXTURATA H. B. Brady.

*Virgulina texturata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 415, pl. 52, figs. 6, *a*, *b*.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 292, pl. 8, fig. 99.

*Description.*—Test elongate, subcylindrical, gradually tapering to the subacute apical end, somewhat compressed; chambers numerous, inflated, about as broad as high, the sutures distinctly depressed; wall calcareous, smooth and polished; aperture elongate, loop-shaped; color white.

Length 1.0–1.3 mm.

*Distribution.*—Although not previously recorded from the North Pacific, this species has occurred at three stations, *Albatross* station H2902, in 1,783 fathoms, and *Nero* stations 166 and 170, in 1,850 and 1,990 fathoms.

The specimens from *Nero* station 166 were very smooth and somewhat different from the typical ones found at the other stations.

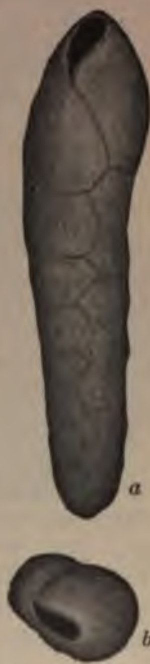


Fig. 149.—Virgulina texturata. × 35. *a*, front view; *b*, apertural view.

## Subfamily 4. CASSIDULININÆ.

This subfamily includes forms which are peculiarly constructed in that there is a combination of two distinct modes of growth. One of these, so usual in this family, is the biserial, which is here combined with a spiral or volute method. The combination of the two makes a complex test.

Two genera are common in the North Pacific, *Cassidulina* and *Ehrenbergina*, both of which are represented by more than one species.

### Genus CASSIDULINA, d'Orbigny, 1826.

*Cassidulina* d'Orbigny (type, *C. lævigata* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 282.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 427.

*Description.*—Test coiled, at least the earlier portion, and the chambers biserially arranged on the sides of the axis of coiling; wall calcareous, perforate, usually smooth; the chambers numerous, with distinct sutures; aperture loop-like, variously modified in the different species.

The most lucid description of the arrangement of the chambers in this genus is that given by Brady, as follows: "The arrangement of the test in *Cassidulina* is in some respects more complex than that of any other type of Foraminifera, inasmuch as it combines two distinct modes of growth, the biserial and the convoluted. This may be best understood by its analogy, in the typical condition, to a broad Textularian or Bolivine shell, doubled or folded longitudinally on the median line, and then rolled in the crease so formed from the narrow to the broad end. The flaps of each convolution extend nearly or quite to the umbilicus, and completely enclose the previous whorls."

In some species there is the tendency to uncoil as in so many other genera which are close coiled. The various species appear to be widely distributed.

### CASSIDULINA LÆVIGATA d'Orbigny.

*Cassidulina lævigata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 282, pl. 15, figs. 4, 5; Modèles, 1826, No. 41.—WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 68, pl. 6, figs. 141, 142.—PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 377, pl. 15, figs. 1–4; pl. 17, fig. 64, *a*, *b*, *c*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 428, pl. 54, figs. 1–3.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 221, pl. 43, fig. 11.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 302, pl. 7, figs. 47, 48, 54–56.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 43, pl. 8, figs. 418–320.—SILVESTRI, Mem. Pont. Accad. Nuovi Lincei, vol. 12, 1896, p. 103, pl. 2, fig. 10.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 1.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 16.—RHUMBLER, Zool. Jahrb., Abth. Syst., vol 24, 1906, p. 62.

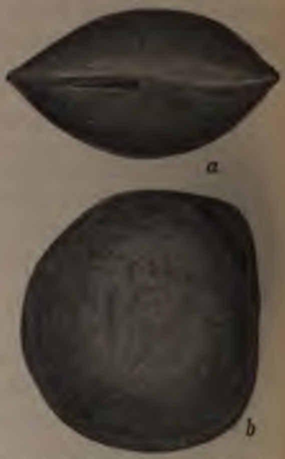


FIG. 150.—CASSIDULINA LÆVIGATA. × 30. *a*, APERTURAL VIEW; *b*, FRONT VIEW.

*Description.*—Nearly circular in outline, lenticular or biconvex with a thin, carinate, peripheral border; chambers numerous, long and narrow, curved, the surface nearly smooth; sutures distinct but hardly depressed; wall calcareous, perforate, smooth; aperture a long narrow slit just below and nearly parallel to the periphery of the test; color white.

Diameter 0.50–0.90 mm.

*Distribution.*—Brady records this species as occurring at three stations in the North Pacific. I have material of this keeled form from but one station, *Albatross* station D4822, in 130 fathoms, off Japan. The other species are all more common in the material from this region, but from the colder waters of Bering Sea as well as on the northern coast of western America this species is common. Rhumbler records a very small specimen measuring 0.234 mm. from Chatham Island.

### CASSIDULINA CRASSA d'Orbigny.

*Cassidulina crassa* D'ORBIGNY, Foram. Amér. Mérid., 1839, p. 56, pl. 7, figs. 18-20; For. Foss. Vienne, 1846, p. 213, pl. 21, figs. 42, 43.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 303, pl. 7, figs. 35, 36.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 43, pl. 8, figs. 421, 422.—EGGER, Nat. Ver. Passau, Jahr. 16, 1895, p. 19, pl. 9, fig. 19.—SILVESTRI, Mem. Pont. Accad. Nuovi Lincei, vol. 12, 1896, p. 104, pl. 2, figs. 11, 12.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 292, pl. 38, fig. 3.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 2.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 17.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 139.

*Cassidulina lævigata*, var. *crassa* PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 377, pl. 15, figs. 5-7; pl. 17, fig. 64*d*.

*Cassidulina obtusa* WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 69, pl. 6, figs. 143, 144.

*Description.*—Outline subcircular or oval, biconvex, with a broadly rounded peripheral border; chambers rather few, short, and nflated, the surface depressed at the sutures; wall calcareous, perforate, smooth; aperture a long narrow slit just below and nearly parallel to the periphery of the test, with a long tooth partially filling the aperture; color, white.

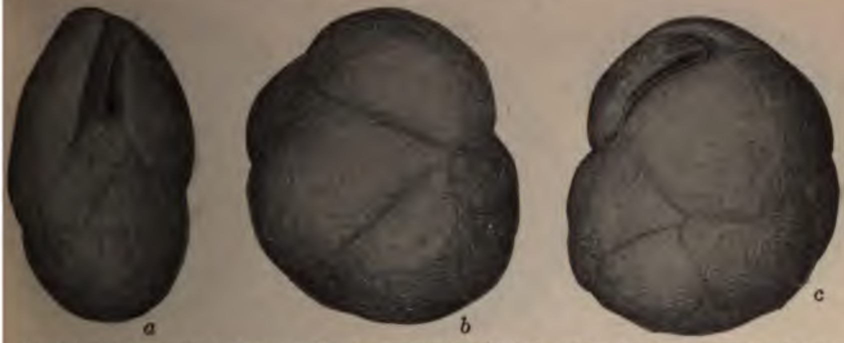


FIG. 151.—CASSIDULINA CRASSA. × 30. *a*, APERTURAL VIEW; *b*, DORSAL VIEW; *c*, VENTRAL VIEW.

Diameter, 0.60–1.00 mm.

*Distribution.*—Brady records this species from five stations in the North Pacific at depths varying from 40 to 2,475 fathoms. Bagg records it from *Albatross* stations H4440 and H4694, in 1,259 and 865 fathoms, respectively, off the Hawaiian Islands. I have had material from three stations off Japan, in 120–142 fathoms, from the Okhotsk Sea in 100 fathoms, from the vicinity of the Aleutian Islands, in 500 fathoms, and from off California, in 65 fathoms. This gives a rather general distribution for the area, and specimens are usually in considerable numbers when found. The broadly rounded periphery will distinguish this species from *C. lævigata*, and its more narrow and elongate aperture and more numerous chambers from *C. subglobosa*. When the aperture is viewed from above there is visible a broad tooth-like plate partially filling the aperture except at the upper end. This gives the aperture a very narrow appearance in some views.

In this region at least *C. crassa* seems to be much more common and more widely distributed than *C. lævigata*.

### CASSIDULINA SUBGLOBOSA H. B. Brady.

*Cassidulina subglobosa* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 60; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 430, pl. 54, figs. 17, *a–c*.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., London, vol. 12, 1888, p. 221, pl. 43, figs. 12–14.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 304, pl. 7, figs. 41, 42, 52, 53.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 49.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 293, pl. 38, figs. 4.—Chapman, Journ. Linn. Soc., vol. 30, 1907, p. 33, pl. 4, fig. 84.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 140.

*Description.*—Test with an oval outline, subglobular, inequilateral, somewhat compressed on the two faces, the peripheral border broadly rounded; chambers few, somewhat inflated; sutures slightly depressed, wall calcareous, perforate, smooth; aperture fairly broad and short, looplike or oval; color, white.

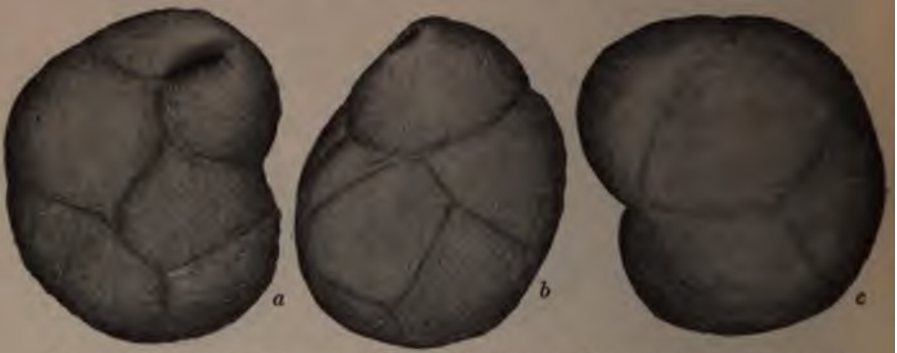


Fig. 152.—Cassidulina subglobosa. × 30. *a*, ventral view; *b*, side view; *c*, dorsal view.

Diameter, 0.50 –1.00 mm.

*Distribution.*—The two stations in the Northwest Pacific from which Brady records this species are in 2,300 and 2,950 fathoms. Goës records the species from the southeastern part of the area in 770–1,201 fathoms, and Bagg found it in material from three *Albatross* stations near the Hawaiian Islands, H4430, H4571, and H4585, in 384–1,259 fathoms. In the *Nero* material this species was very common in the area between Guam and Japan at an average depth of about 1,500 fathoms. Specimens from the *Albatross* material from off the coast of Japan were dredged in 130 and 200 fathoms. In the *Tuscarora* material this species occurred at several stations: station 2, in 1,468 fathoms, near the Hawaiian Islands; station 13, in 190 fathoms, off the coast of California; station 23, in

1,964 fathoms, in the middle of the Pacific, south of Midway Island; station 41, in 530 fathoms, off California; and station 83, in 282 fathoms, off the western Aleutian Islands. Taken with the other records these give a rather broad distribution, including most parts of the North Pacific, as well as rather wide ranges in depth.

The species is very distinct from the others of the genus, the subglobose form, and the short oval or loop-like aperture serving to distinguish it at once.

### CASSIDULINA ELEGANS Sidebottom.

*Cassidulina elegans* Sidebottom, Journ. Queckett Micr. Club, ser. 2, vol. 11, 1910, p. 106, pl. 4, figs. 1, *b*, *c*.

*Description.*—Test somewhat globular, somewhat compressed laterally; chambers numerous, distinct; sutures fairly deep; wall of the distal border of the chambers often raised into a well-marked keel; surface somewhat roughened; aperture a curved loop-like slit, oblique, with a raised border.

Diameter, 0.40–0.60 mm.

*Distribution.*—This species, recently described by Sidebottom from the Southwest Pacific, occurred at four *Nero* stations between Guam and Japan as follows, 1301, in 1,088 fathoms, 1308, in 1,040 fathoms, 1309, 891 fathoms, and 1464, in 891 fathoms.

This species is ornate with raised ridges and is at once distinguished from all other species of the genus.

### CASSIDULINA BRADYI Norman.

*Cassidulina bradyi* (Norman, MS.) Wright, Proc. Belfast Nat. Field Club, App., 1880, p. 152.—H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 59; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 431, pl. 54, figs. 6–10.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 304, pl. 7, figs. 38–40.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 44, pl. 8, figs. 423–426; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 49.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 17, pl. 3, fig. 10.

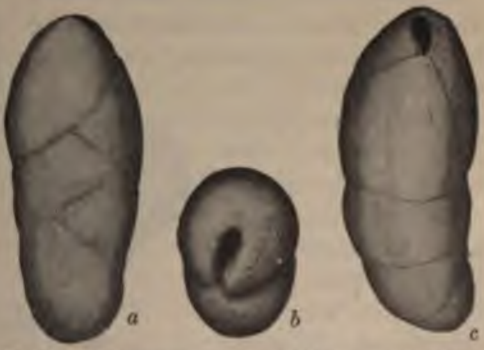


Fig. 153.—Cassidulina bradyi. × 60. *a*, view from dorsal side; *b*, apertural view; *c*, side view.

*Description.*—Test elongate, compressed, the early portion spirally coiled, the later chambers forming an uncoiled biserial series; lateral faces convex; peripheral border thin, either acute or (usually) somewhat rounded; chambers fairly long, very slightly inflated; suture very slightly depressed; wall calcareous, smooth; aperture broad and short, loop-like or oval on the inner face of the chamber; color, white.

Length, 0.40–0.80 mm.

*Distribution.*—Brady records this species from two North Pacific stations, in 95 fathoms, off the Philippines and, in 345 fathoms, on the *Hyalonema*-ground south of Japan. I have had specimens from *Nero* station 1464, in 891 fathoms, near Guam; station 170, in 1,990 fathoms, off Midway Island, and station 2049, in 2,226 fathoms, near the Hawaiian Islands. There is a single specimen of this species from *Tuscarora* station 47, in 1,499 fathoms, in the Western Pacific. This species is interesting in showing the development of an uncoiled form, a process which is carried still farther by the following.

### CASSIDULINA PARKERIANA H. B. Brady.

*Cassidulina parkeriana* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 59; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 432, pl. 54, figs. 11-16.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ɪɪ, vol. 18, 1893, p. 304, pl. 7, fig. 37.

*Description.*—Test elongate, cylindrical, the very early portion spirally coiled, the later chambers forming an uncoiled biserial series, making up the larger part of the test, circular in cross section; chambers broad and high, considerably inflated; sutures much depressed; wall calcareous, smooth; aperture very broad and short, occasionally subcircular, often with a broad tooth-like plate nearly filling the opening; color, white.

Length, 0.50–0.65 mm.

*Distribution.*—This species has not been previously recorded from the North Pacific. Brady's specimens were dredged by the *Challenger* among the islands on the west coast of Patagonia, and our specimens are from the same coast of the Pacific. Single specimens were obtained at *Albatross* stations D2806, in 1,379 fathoms, near the Galapagos, and D3608, in 276 fathoms, in the Bering Sea.

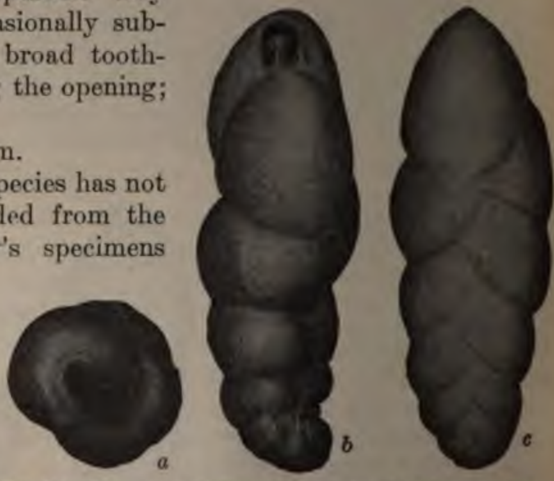


Fig. 154.—Cassidulina parkeriana. × 50. *a*, apertural view; *b*, ventral view; *c*, dorsal view.

The species carries the uncoiling to an extreme and develops a cylindrical test with the aperture nearly terminal and rounded, but keeps to the biserial condition, although in some specimens the chambers nearly separate those adjacent.

### Genus EHRENBERGINA Reuss, 1850.

*Ehrenbergina* **Reuss** (type, *E. serrata* Reuss), Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 377.—H. B. **Brady**, Rep Voy *Challenger*, Zoology, vol. 9, 1884, p. 433.

*Cassidulina* (part) **d'Orbigny**, Foram. Amér. Mérid., 1839, p. 57.

*Description.*—Test free, composed of numerous chambers arranged biserially about an elongate axis, evenly united on the dorsal border but forming a deep groove on the ventral border, generally triangular in cross section; wall calcareous; aperture elongate, nearly at right angles to the edge of the chamber, smooth or ornamented with spines or ridges.

Brady, in the *Challenger* Report, speaks of this genus as almost confined to the southern hemisphere. This has been largely due to lack of material, in the Pacific at least, for in the present work it has been found at a great many stations and often in very considerable numbers.

#### EHRENBERGINA SERRATA Reuss.

*Ehrenbergina serrata* **Reuss**, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 377, pl. 48, fig. 7.—**Bronn**, Leth. Geog., ed. 3, vol. 3, 1853–6, p. 231, pl. 35, figs. 25 *a–c*.—**Schwager**, Boll. Roy. Com. Geol. Ital., vol. 8, 1877, p. 26, pl. 68.—H. B. **Brady**, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 434, pl. 55, figs. 2–7.—**Egger**, Ahh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, pl. 7, figs. 30–32.—**Goës**, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 44, pl. 8, figs. 428–430.—**Chapman**, Proc. Zool. Soc. London, 1895, p. 26.—**Bagg**, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 140.

*Ehrenbergina serrata*, var. *trigona* **Goës**, Bull. Mus Comp. Zoöl., vol. 29, 1896, p. 49.

*Textularia triquetra* **Münster**, var., **Goës**, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 83, pl. 6, figs. 181, 182.

*Description.*—Test longer than wide, of several chambers, arranged biserially about a central axis, on the dorsal side meeting evenly to form a smooth surface, on the ventral often leaving a deep groove between the two adjacent series of chambers, or smooth; test triangular, ovoid, or biconvex in transverse section; angles of the test carinate, often produced into short spines; wall calcareous, finely perforate; aperture an elongate, somewhat curved slit; color white. Length about 0.5 mm.

*Distribution.*—There are a number of records published for this species in the North Pacific. Brady, in the *Challenger* Report, records it from but one station, in 2,340 fathoms. Goës found it in material from two stations, off the west coast of America, *Albatross* stations 3375 and 3400, in 1,201 and 1,322 fathoms; Bagg records it from five *Albatross* stations in the vicinity of the Hawaiian Islands, varying in depth from 367–1,544 fathoms. I have had material from thirty or more stations in the North Pacific. It was found in material from *Albatross* station D2806 in 1,379 fathoms near the Galapagos Islands; it occurred several times in the line of soundings from San Francisco to the Hawaiian Islands, in 392–2,615 fathoms, and in the *Nero* material from about the Hawaiian Islands and Guam, and is common between Guam and Japan at many stations. Among variously scattered *Tuscarora* stations it occurs in 500 fathoms just south of the Aleutian Islands. It is a fairly common constituent of globigerina-ooze and volcanic muds in a number of areas of the North Pacific, according to the data available.

There seems to be some variation in the shape and the amount of spinosity developed. In general the more triangular forms are most spinose and the biconvex forms often almost smooth and frequently with the long axis of the test considerably curved.

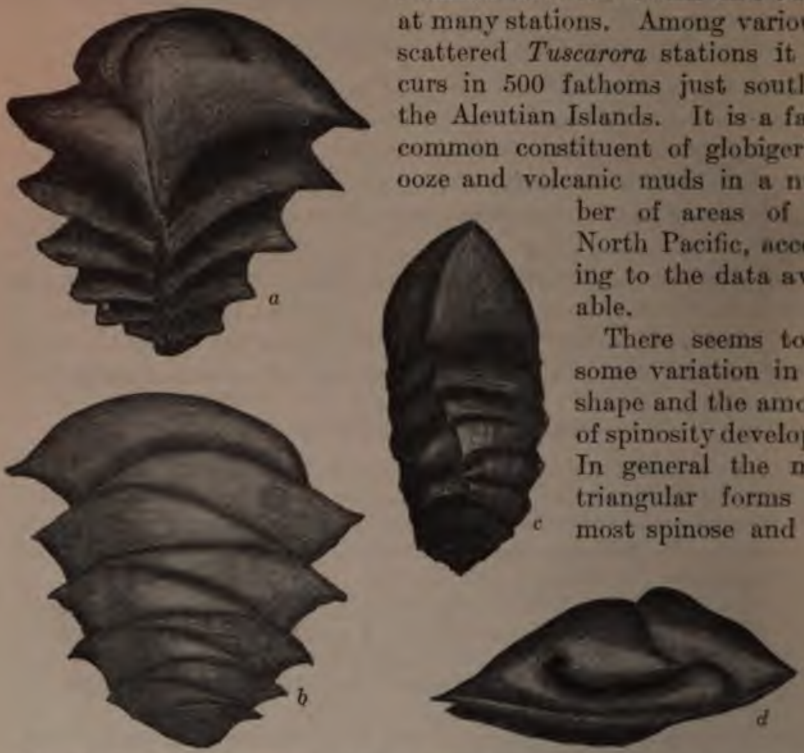


FIG. 155.—EHRENBERGINA SERRATA. × 75. *a*, VENTRAL VIEW; *b*, DORSAL VIEW; *c*, SIDE VIEW; *d*, APERTURAL VIEW.

### EHRENBERGINA HYSTRIX H. B. Brady.

*Ehrenbergina hystrix* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 60; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 434, pl. 55, figs. 8–11.—FLINT, Bull. 55, U. S. Nat. Mus., 1905, pp. 16, 19.

*Description.*—Test free, biserial, nearly as broad as long, stout; dorsal border with spines often coalescing laterally to make a fringe-like projection, later chambers smooth dorsally, the lateral margins and ventral portion with large stout spines, the last developed chamber often smooth and somewhat inflated, marked with fine raised lines running radially outward from the aperture; wall fairly thick, calcareous; aperture elongate, rounded at the inner end; color white.

Length up to 1 mm.

*Distribution.*—The only published records for the North Pacific are those of Flint, who found it in the *Nero* material from three stations. I have found it in material from two of these same stations and from a number of others, most of them northwest of the Hawaiian Islands. It occurred also near the Bonin Islands and at one *Albatross* station, H2902, east of the Hawaiian Islands. All of these records are from rather deep water, ranging from 1,321–2,203 fathoms, mostly from globigerina ooze.

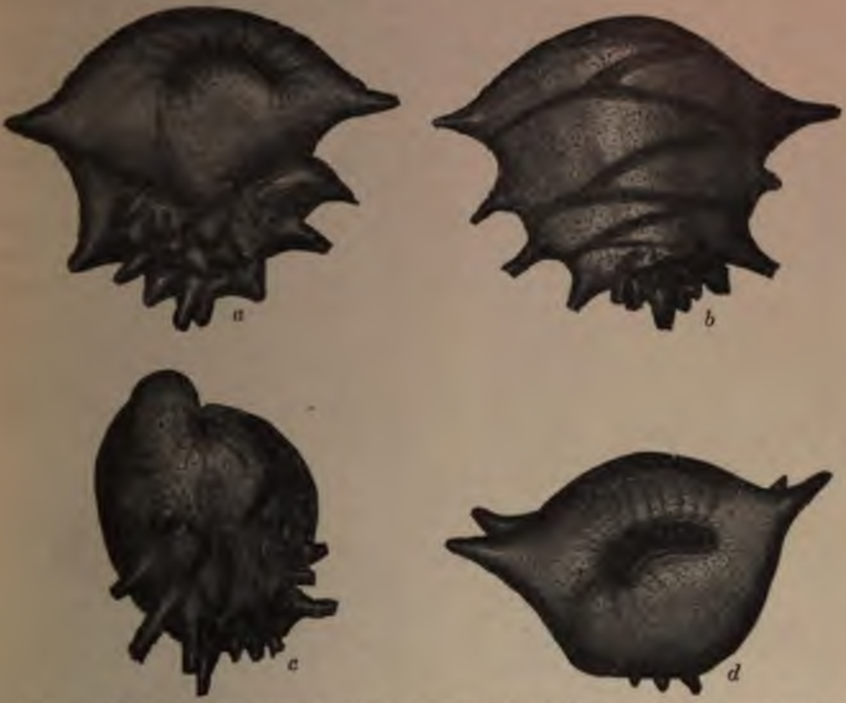


FIG. 156.—EHRENBERGINA HYSTRIX. × 40. *a*, VENTRAL VIEW; *b*, DORSAL VIEW; *c*, SIDE VIEW; *d*, APERTURAL VIEW.

The *Challenger* records for this species are all from the South Pacific, in rather deep water. This species is much more robust than the preceding; the shorter and stouter spines and the broad last formed chamber with its ornamentation of radial lines and the shape of the aperture are all very different from the conditions seen in *E. serrata*.

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Bulletin 71

# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN

## PART III. LAGENIDÆ

BY

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# INTRODUCTION.

The present volume is the third of a series dealing with the Foraminifera of the North Pacific Ocean. It contains the Foraminifera included in the family Lagenidæ. The first part, issued in 1910, included the families Astrorhizidæ and Lituolidæ. The second part, issued in 1911, included the family Textulariidæ. The fourth part will be devoted to the Chilostomellidæ, Globigerinidæ and Nummulitidæ, and further volumes will take up the remaining families of the Foraminifera as they are represented in the North Pacific.

JOSEPH AUGUSTINE CUSHMAN.

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# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN.

## LAGENIDÆ.

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## INTRODUCTION.

This third part of the work on the North Pacific Foraminifera deals entirely with the Lagenidæ, a family following in natural sequence those families already considered in the two earlier parts. The same arrangement of data is here adopted.

The treatment of the Lagenidæ will be found perhaps more conservative than that adopted in the earlier parts. This is due mainly to the much greater amount of work that has been done on this family by students of the Foraminifera. The Lagenidæ have seemingly always been a favorite with workers on the group, and the amount of literature is far greater than that on the families thus far considered.

There have been a number of works treating of the genus *Lagena* alone, and it has therefore been unnecessary to describe any great number of new species. The recent publication of Mr. Sidebottom on *Lagena*[1] has been of great assistance.

With the working out of the distribution of various species the faunal areas of the North Pacific have become more clearly defined. The number of species found at some stations of the United States Bureau of Fisheries steamer *Albatross*, off southern Japan, which are recorded by Brady from off the Philippines, is very considerable.

In addition to determining restrictions of range it has been possible to greatly extend the known range of certain species.

In this part, in addition to the data given in the other parts, the bottom temperature record of the station has been given in many cases. With certain species this seems to have a definite bearing on the distribution.

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[1] Journ. Quekett Micr. Club, vol. 11, 1912.

A systematic presentation of the various groups of the family follows:

## Family 5. LAGENIDÆ.

Test calcareous, vitreous, finely perforate; either monothalamous or made up of a series of chambers arranged in a straight or curved axis, or close coiled or spirally, or even in an alternating manner; aperture either radiate or simple, with a neck and phialine lip.

The Lagenidæ form one of the most distinctive groups of the Foraminifera and its members are readily recognized. Usually the genus *Lagena*, making up the subfamily Lagenidæ, has been taken as the radicle from which the other genera have been derived. Species like *L. globosa* probably come as near a primitive radicle for this family as it is possible to determine.

From *Lagena* the simplest step in development is a series of such chambers as is seen in *Nodosaria*. On the other hand this series may become coiled as in *Cristellaria*. With these two genera as the base all the genera of the subfamily Nodosariinæ may be definitely assigned to one or the other groups. With *Nodosaria* belong such genera as *Lingulina* and *Triplasia* and with *Cristellaria* as reversionary forms, *Marginulina*, *Vaginulina*, and *Frondicularia*.

With the subfamily Polymorphininæ a distinct mode of development is instituted, an alternating subspiral arrangement being introduced, usually accompanied by a radiate type of aperture.

In the subfamily Uvigerininæ there is again a spiral arrangement, much more definite in its characters and the aperture typically has a long neck and phialine lip.

### Subfamily 1. LAGENINÆ.

Test consisting of a single chamber, the aperture either ecto- or entosolenian.

This subfamily includes the single genus *Lagena*.

### Genus LAGENA Walker and Boys, 1784.

*Lagena* Walker and Boys (type, *L. globosa* (Montagu)), Test. Min., 1784, p. 3.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 440.

*Description.*—Test monothalamous, smooth or ornamented, generally flask-shaped, aperture ecto- or entosolenian.

The genus *Lagena* is one of the largest in point of view of numbers of described species and varieties of any of the genera of the Foraminifera. The opinion as to the limits of variation in the group varies with nearly every student of the group. In the material I have examined I have again and again been made aware of the similarity, even the almost identical character of ornamentation in specimens from widely separated stations, but usually in the same faunal area. Then, too, there must be recognized a considerable amount of variation in the group as well. The whole problem of *Lagena* is a very puzzling one, but the greater the amount of material from a given area the more definite these limits of variation seem. With a large series of specimens from a given faunal area it would seem that the limits of variation might be rather definitely fixed and a more orderly system brought out of the present somewhat chaotic condition.

In describing the various species and varieties of *Lagena* a general scheme has been adopted of keeping those species together which have similarities of ornamentation. In this way they may be most easily grouped, and this has been the method usually followed by previous writers.

On the basis of the aperture various names have been used in a generic sense, such as *Entosolenia*, *Fissurina*, *Phialina*, and so on, and on the basis of form many others have been used. The value of these groupings can only be tested by the study of large series as has already been suggested.

I have not tried to make the synonymy in any sense complete, as the whole literature in regard to the genus is in such a chaotic state. The following species and varieties have been recognized from the North Pacific:

#### LAGENA GLOBOSA (Montagu).

Plate 4, fig. 2.

"Serpula (Lagena) laevis globosa" Walker and Boys, Test. Min., 1784, p. 3, pl. 1, fig. 8.

*Vermiculum globosum* Montagu, Test. Brit., 1803, p. 523.

*Lagena globosa* Brown, Illus. Rec. Conch. Great Britain and Ireland, ed. 1, 1827, pl. 1, fig. 37; ed. 2, 1884, p. 126, pl. 56, fig. 37.—Reuss, Sitz. kais. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 318, pl. 1, figs. 1-3; Bull.

Acad. Roy. Belg., ser. 2, vol. 15, 1853, p. 143, pl. 1, figs. 13, 14.—Jones, Parker, and H. B. Brady, Pal. Soc. Mon., vol. 19, 1866, p. 32, pl. 1, fig. 32.—Butschli, in Bronn, Klassen und Ordnungen Thier-Reichs, vol. 1, 1880, p. 197, pl. 7, fig. 2.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 26, pl. 1, fig. 7.—Terrigi, Atti Accad. Pont. Nuovi Lincei, vol. 35, 1883, p. 170, pl. 2, fig. 3.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 452, pl. 56, figs. 1–3.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 336.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 744, pl. 14, fig. 11.—Haeusler, Neues Jahrb. für Min., 1887, pt. 1, p. 181, pl. 4, figs. 1–4 (not 5–18).—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 221.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 477.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 323, pl. 10, fig. 69.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 77, pl. 13, fig. 741.—Chapman, Proc. Zool. Soc. London, 1895, p. 27.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, pt. 4, 1897, p. 116, pl. 1, fig. 1.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 102, pl. 5, fig. 3.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 4.—Kiaer, Rep. Norwegian Fish. Mar. Invest., vol. 1, No. 7, 1900, p. 39, pl., fig. 17.—Millett, Journ. Roy. Micr. Soc., 1901, p. 3.—Rhumbler, Zool. Jahrb. Abth. Syst., vol. 24, 1906, p. 63.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 14.

*Entosolenia globosa* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 16, pl. 2, figs. 13, 14; Rec. Foram. Great Britain, 1858, p. 8, pl. 1, figs. 15, 16.—Dawson, Can. Nat., vol. 4, 1859, p. 28, figs. 4, 5; vol. 6, 1872, p. 254, pl. 3, fig. 2.

*Lagena sulcata*, var. (*Entosolenia*) *globosa* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 348, pl. 13, figs, 37*a*, *b;* pl. 16, figs. 10*a*, *b*.

*Description.*—Test subspherical, smooth, aperture either stellate or

### LAGENA OVUM (Ehrenberg).

Plate 2, fig. 2.

*Miliola ovum* Ehrenberg, Berlin Monatsber., 1843, p. 166; Mikrogeologie, 1854, pl. 23, fig. 2; pl. 29, fig. 45; pl. 31, fig. 4.

*Lagena ovum* Marsson, Mitth. nat. Ver. Neu-Vorpom. Rügen. Jahrg. 10, 1878, p. 120, pl. 1, fig. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 454, pl. 56, fig. 5.

*Description.*—Test elongate, elliptical in front view, nearly circular in cross section, slightly compressed, ends broadly rounded, nearly equal; wall thin, transparent, smooth: aperture broadly elliptical, central, with a comparatively short entosolenian neck.

Length 0.4 mm.; breadth 0.2 mm.

*Distribution.*—Brady records this species from a single *Challenger* station in the North Pacific, in 2,300 fathoms. Specimens apparently referable to this species have occurred at three *Nero* stations, 1129 in 1,505 fathoms between Guam and Yokohama, 2049 in 2,226 fathoms, and 2064 in 1,355 fathoms, both off the Hawaiian Islands.

Ehrenberg's figures referred to *Miliola* are rather crude and indeterminate to which to assign this recent species, and it may be questioned whether this is a wholly satisfactory disposal of these almost elliptical forms.

### LAGENA LÆVIS (Montagu).

Plate 1, fig. 3; plate 38, fig. 5.

"Serpula (Lagena) lævis ovalis" Walker and Boys, Test. Min., 1784, p. 3, pl. 1, fig. 9.

*Vermiculum læve* Montagu, Test. Brit., 1803, p. 524.

*Lagenula lævis* Fleming, Brit. Anim., 1828, p. 235.

*Lagena lævis* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 12, pl. 1, figs. 1, 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 455.—Jones, Quart. Journ. Geol. Soc., vol. 40, 1884, p. 769, pl. 34, fig. 3 [?].—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 744, pl. 14, fig. 13.—Haeusler, Neues Jahrb. für Min., pt. 1, 1887, p. 181, pl. 4, figs. 31–49.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 4, vol. 10, 1890, p. 466, pl. 1, fig. 1.—Mariani, Boll. Soc. Geol. Ital., vol. 10, 1891, p. 725, pl. 21, fig. 9.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 478.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 3, 1893, p. 431, pl. 2, fig. 1.—Chapman, Journ. Roy. Micr. Soc., 1893, p. 581, pl. 8, fig. 5.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 74, pl. 13, figs. 719–722.—Egger, Jahrb. 16, Nat. Ver. Passau, 1895, p. 24, pl. 2, fig. 11.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 51.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 7, 1898, p. 210, pl., fig. 19.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 102, pl. 5, fig. 2.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 6.—Wright, in Meade, Geol. Mag., dec. 4, vol. 7, 1900, p. 100, pl. 5, fig. 12.—Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 17, 1900, p. 244, pl. 6, fig. 56.—Millett, Journ. Roy. Micr. Soc., 1901, p. 9.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.

*Miliola lævis* Ehrenberg, Mikrogeologie, 1854, pl. 26, fig. 2; pl. 31, fig. 5.

*Ovulina clava* EHRENBERG, Mikrogeologie, 1854, pl. 32, II, fig. 2*b*.

*Lagena vulgaris* WILLIAMSON, Rec. For. Great Britain, 1858, p. 4, pl. 1, figs. 5, 5*a*.—REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862, p. 321, pl. 1, fig. 15; pl. 2, figs. 16, 17.

*Lagena sulcata*, var. *lævis* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 349, pl. 13, fig. 22; pl. 16, fig. 9*a*.

*Description.*—Test in front view oval, elliptical, or nearly circular, with a more or less elongate neck, in cross section subcircular; wall smooth, usually transparent; aperture at the end of the elongate neck, which often has a phialine lip.

Length up to 0.8 mm.; diameter up to 0.4 mm.

*Distribution.*—This species from the records would seem to be very common everywhere in the present oceans and in all the geological formations in which Foraminifera occur, but in the North Pacific material examined the species has occurred but a few times. Brady records it from several stations, but none of the figures in the *Challenger* report represent the typical species, and most of them may be referred to other things. All the specimens I have had came from the *Nero* and *Albatross* material dredged off Japan and between there and Guam, in 437 to 2,250 fathoms. Bagg records it from off the Hawaiian Islands and Goës from the western coast of America.

The synonymy of this species is interesting, including a very great range of things, some smooth, others striate, hispid, and variously ornamented, and in form a great many varied shapes are placed here. Without the original material it is useless to try to straighten out this perplexity of figures, as some of them in the older works are

*Distribution.*—This species seems to be rare in the North Pacific, having been noted but once in the material examined, *Nero* station 10, in 2,098 fathoms, west of the Hawaiian Islands.

This seems to be distinct from the form here referred to *L. sacculus* Fornasini, as the outline is more nearly that of the figures given by Reuss and the exterior is very smoothly sloping without an accentuation of the central chamber as in the species *L. sacculus*.

### LAGENA LÆVIGATA (Reuss).

Plate 2, fig. 1.

*Fissurina lævigata* REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 366, pl. 46, fig. 1; Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 338, pl. 6, fig. 84.—TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 30, pl. 1 (9), figs. 17 *a*, *b*.

*Lagena lævigata* TERRIGI, Atti Accad. Pont. Nuovi Lincei, vol. 33, 1880, p. 177, pl. 1, fig. 6.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 473, pl. 114, figs. 8 *a*, *b*.—BLACKWILL and MILLETT, Journ. Micr., vol. 3, 1884, p. 81, pl. 2, fig. 6.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 330, pl. 10, figs. 64, 65.—MADSEN, Medd. fra Dansk. Geol. Forening, No. 2, 1895, pp. 74, 195, pl., fig. 3.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 493.—SIDEBOTTOM, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 5, pl. 1, fig. 6 [?].

*Fissurina globosa* BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 317, pl. 12, fig. 4.

*Lagena marginata* HAEUSLER, Neues Jahrb. für Min., 1887, pt. 1, p. 186, pl. 4, figs. 51, 52 (not *Vermiculum marginatum* Montagu).

*Description.*—Test subglobose, compressed, somewhat pyriform in front view, in cross section elliptical; wall smooth, transparent in thin specimens or opaque in more thickened ones, along the lateral margins usually clear even in thickened specimens; aperture elongate, fairly narrow, connecting with the interior by a fairly long entosolenian neck.

Length up to 1 mm.; breadth slightly less.

*Distribution.*—Brady records this species at four *Challenger* stations in the western and middle North Pacific from 1,850 to 3,125 fathoms in depth. In the material which I have examined it has occurred at many *Nero* and *Tuscarora* stations from the Hawaiian Islands to Japan, the depths varying from 1,186 to 2,086 fathoms.

This species is common everywhere from existing records, yet fails to appear as would be expected in lists from certain regions. This may be due to the fact that the figure in the *Challenger* Report was not placed on the plates with the others but is near the end of the volume and may have been overlooked.

### LAGENA SACCULUS Fornasini.

Plate 3, figs. 1–3.

*Lagena acuta* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 474, pl. 59, figs. 6*a*, *b* (not *L. acuta* (Reuss)).

*Lagena acuta*, var. *sacculus* Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 9, 1901, p. 49, fig. 3.

*Description.*—Test usually somewhat carinate, body of test in front view nearly circular, in end view broadly elliptical, neck somewhat variable in length and breadth, but varying correspondingly with the development of the carina, which may be very slight or rather well developed according to the specimen; wall smooth, fairly thick, either transparent and distinctly punctate or thickened and nearly opaque, aboral end of test extending out into an acute angled process; aperture at the exterior elongate, elliptical, with a well-developed entosolenian neck extending well into the central cavity of the test, usually with the inner end somewhat expanded, carina when well developed often showing radial lines formed by punctæ extending in from its periphery.

Length up to 0.6 mm.

*Distribution.*—Well distributed in the *Nero* material from the region west of the Hawaiian Islands to Guam and the coast of Japan. The depths of the stations at which this species was taken vary from 1,088 to 2,225 fathoms, most of the stations being more than 1,500 fathoms in depth. There are records for two *Challenger* stations, 241 in 2,300 fathoms and 244 in 1,850 fathoms, both east from Japan.

This is one of the species in which a definite variation seems to

### LAGENA CLAVATA (d'Orbigny).

Plate 2, fig. 3.

*Oolina clavata* D'ORBIGNY, For. Foss. Vienne, 1846, p. 24, pl. 1, fig. 2.

*Lagena clavata* MACKIE, Recreative Science, vol. 1, 1859, p. 148, fig. 13.—REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 320, pl. 1, figs. 13, 14.—TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 25, pl. 1 (9), fig. 2.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 456.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 324, pl. 10, fig. 68.—HAEUSLER, Abh. schweiz. Pal. Ges., vol. 20, 1893, p. 14, pl. 1, figs. 17–22.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 75, pl. 13, figs. 725–727.—MORTON, Proc. Portland Soc. Nat. Hist., vol. 2, pt. 4, 1897, p. 116, pl. 1, fig. 2.—FORNASINI, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 7, 1897 (1898), p. 14 (206), pl., fig. 18.—WRIGHT, in Meade, Geol. Mag., dec. 4, vol. 7, 1900, p. 100, pl. 5, fig. 13.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 490.

*Lagena lævis*, var. *amphora* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 12, pl. 1, figs. 3, 4.

*Lagena lævis* HAEUSLER, Neues Jahrb., 1887, pt. 1, p. 181, pl. 4, figs. 39–48; Abh. schweiz. Pal. Ges., vol. 17, 1890, p. 86, pl. 13, figs. 17, 18.

*Lagena vulgaris*, var. *clavata* WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 5, pl. 1, fig. 6.

*Lagena lævis*, var. *clavata* WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 478.

*Description.*—Test elongate, clavate or fusiform, with a long neck t the oral end and an elongation of the test somewhat variable in ength at the aboral end, surface smooth, cross section nearly circular, all thin and transparent, aperture nearly circular, at the end of the eck, often with a phialine lip.

Length up to 1 mm.

*Distribution.*—Apparently this species is not definitely recorded rom the North Pacific. The only material I have had referable to his species was from *Nero* station 1466 in 234 fathoms near Guam.

### LAGENA LATERALIS, new species.

Plate 1, fig. 1.

*Description.*—Test elongate, somewhat compressed, broadest ward the basal end, apertural end somewhat tapering, both ends roadly rounded, the basal end somewhat truncate, end view oval; all smooth, transparent or nearly so, the flattened sides closely t with punctæ, the lateral margins without punctæ, aperture teral, at one side below the apex, elongate, elliptical with lip-like argins, with a long entosolenian neck more than half the length f the test, flaring at its inner end.

Length about 0.45 mm.; broadest diameter about 0.2 mm.

*Distribution.*—Type-specimen, Cat. No. 8524, U.S.N.M., from *lbatross* D4974 in 905 fathoms off Yokohama, Japan. Specimens also occurred at several *Nero* stations and one *Tuscarora* station between Guam and Yokohama in 660 to 2,104 fathoms. There was little variation observed in the specimens from these six stations.

The specimens figured by Brady[1] may very probably belong to this species. They have the broad-lipped aperture at one side of the axis while Reuss's examples of *L. apiculata* have a definite stellate aperture.

### LAGENA COLLARIS, new species.

Plate 1, fig. 2.

*Description.*—Test elongate, ovoid in front view, widest near the aboral end, apertural end with a deep constriction somewhat in from the actual end; cross section circular, wall thin, transparent, smooth; aperture nearly circular, opening into a separate cavity which connects with the larger part of the test by a short entosolenian tube.

Length 0.35 mm.; breadth 0.2 mm.

*Distribution.*—Type-specimen, Cat. No. 8525, U.S.N.M., from *Nero* station 1147 in 1,856 fathoms, midway between Yokohama and Guam.

The external constriction in the test seems to really mark the apex of the test and the small portion above is a supra-added chamber-like portion of the test with its own aperture to the exterior. From the level of the constriction or slightly above there is a short entosolenian tube passing downward into the main cavity of the test.

### LAGENA FELSINEA Fornasini.

Plate 4, fig. 1.

### LAGENA GRACILLIMA (Seguenza).

Plate 1, fig. 4.

*Amphorina gracilis* Costa, Atti Accad. Pontiniana, vol. 7, 1856, p. 121, pl. 11, fig. 11.

*Amphorina gracillima* Seguenza, Foram. mon. Mioc. Messina, 1862, p. 51, pl. 1, fig. 37.

*Lagena gracillima* Jones, Parker, and H. B. Brady, Pal. Soc. Mon., vol. 19, 1866, p. 45, pl. 1, figs. 36, 37.—H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 292, pl. 11, figs. 6*a–c*.—Butschli, in Bronn, Klassen und Ordnungen Thier-Reichs, vol. 1, 1880, p. 197, pl. 7, fig. 20.—Fornasini, Boll. Soc. Geol. Ital., vol. 2, 1883, p. 185, pl. 2, fig. 5.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 456, pl. 56, figs. 21, 22, 24–26 [19? 20? 23? 27? 28?].—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 330, pl. 10, fig. 12.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 75, pl. 13, fig. 729 (not 728, 730); Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 52.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 3.—Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 17, 1900, p. 245, pl. 6, fig. 42.—Millett, Journ. Roy. Micr. Soc., 1901, p. 491.

*Lagena sulcata*, var. *distoma-polita* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 357, pl. 13, fig. 21; pl. 18, fig. 8.

*Lagena lævis*, var. *gracillima* Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 478.

*Description.*—Test much elongate, slender, broadest near the middle, thence tapering toward either end and continued out into a long slender tubular neck at each end, apertural end with a definite rim at the apex when complete and the opposite end probably closed in perfect specimens, delicate, wall thin and hyaline, smooth; transparent.

Length up to 1.5 mm.

*Distribution.*—This species is recorded by Brady from three *Challenger* stations; 206 in 2,100 fathoms in the China Sea; 241 in 2,300 fathoms east of Japan; and 232 in 345 fathoms on the *Hyalonema*-ground south of Japan. Goës records it from three *Albatross* stations off the west coast of America in 782, 1,132, and 1,832 fathoms. In the material I have had the species has occurred in these same two regions, *Albatross* D4775 in 584 fathoms and D4964 in 37 fathoms, both off Japan, and *Tuscarora* station 9, in 980 fathoms off southern California.

Although this species is usually described as having an aperture at both ends it seems to me that this is accidental, and that in perfect specimens the aboral end will be found to be closed. Owing to the extreme tenuity of the ends and the fragile character of the wall, the perfect aperture with its prominent lip is seen in but a small per cent of the specimens examined. This is apparently due to breakage in handling the material. The same is probably true of the aboral end, for no trace of a lip or other indication of a finished end is noted either in specimens or figures of this species. The complete apertural end is shown in the accompanying figure and in the figure given by Parker and Jones (pl. 18, fig. 8). There may be gradations between this species and *Lagena elongata*, but as far as seen *L. gracillima* has the main portion of the test decidedly fusiform, while in *L. elongata* the sides are usually nearly parallel for a considerable portion of their length.

The specimen figured by Flint, which in his figure (pl. 53, fig. 3) is shown as the second specimen from the left side, is the most perfect I have seen and shows the perfect apertural lip and the almost perfect aboral end terminating in a very delicately pointed tip. Some of the other specimens in this set had perhaps best be referred to *L. elongata*.

### LAGENA ELONGATA (Ehrenberg).

Plate 1, fig. 5.

*Miliola elongata* EHRENBERG, Bericht preuss. Akad. Wiss. Berlin, 1844, p. 274, 1845, p. 371; Mikrogeologie, 1854, pl. 25, fig. 1.

*Lagena elongata* TATE and BLAKE, Yorkshire Lias, 1876, p. 454, pl. 18, figs. 9, 9a.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 457, pl. 56, fig. 29.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 75, pl. 13, fig. 731.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 1.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 492, pl. 8, fig. 10.—CHAPMAN, Trans. New Zealand Inst., vol. 38, 1905, p. 91.

*Lagena gracillima* (part) H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 56, figs. 27, 28.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, pl. 13, figs. 728, 730 (not 729).

*Lagena vulgaris*, var. *distoma-polita* RYMER-JONES (part), Trans. Linn. Soc. London, vol. 30, 1875, p. 64, pl. 19, fig. 55.

The original figure given by Ehrenberg is a rather poor one, but may e this species. Egger's figure[1] has prominent lines of punctæ which re not typical of this species, and apparently does not belong here.

### LAGENA APICULATA (Reuss).

*Oolina apiculata* Reuss, in Haidinger's Nat. Abhandl., vol. 4, 1850, p. 22, pl. 1, fig. 1.

*Lagena apiculata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862 (1863), p. 319, pl. 1, figs. 4–8, 10, 11.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 453, pl. 56, figs. 4, 15–18.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 80, pl. 13, fig. 747.—Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 381, pl. 14, figs. 16–18.

*Description.*—Test subglobose, smooth, entosolenian, but slightly if at all compressed, apical end with a pointed spine, variable in length. Length 0.5 mm.

*Distribution.*—This species is recorded in the Summary of Results of the *Challenger* Report at stations in the western Pacific down to 2,300 fathoms. I have had a specimen from *Nero* station 1155 in 1,652 fathoms between Guam and Yokohama.

### LAGENA HISPIDA Reuss.

Plate 4, figs. 4, 5; plate 5, fig. 1.

"Sphaerulæ hispidæ" Soldani, Testaceographia, vol. 2, 1798, p. 53, pl. 17, figs. V, X.

*Lagena hispida* Reuss, Zeitschr. deutsch. geol. Ges., vol. 10, 1858, p. 43; Sitz. Akad. Wiss. Wien, vol. 46, 1863, p. 335, pl. 6, figs. 77–79.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 459, pl. 57, figs. 1–4; pl. 59, figs. 2, 5.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 324, pl. 10, fig. 26.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 307, pl. 53, fig. 8.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 385, pl. 14, fig. 31; pl. 15, figs. 1, 2.

*Description.*—Test variously formed, globular to pyriform, the surface clothed with delicate spines uniformly distributed over the test. Length 0.4 to 0.8 mm.

*Distribution.*—Brady records this species at a single *Challenger* tation in the North Pacific off Japan in 345 fathoms. Bagg records from the vicinity of the Hawaiian Islands, *Albatross* station H4585 689 fathoms. I have material from *Nero* station 2037 in 55 fathoms ff the Hawaiian Islands, 1147 in 1,856 fathoms and *Albatross* D4891 181 fathoms, both off Japan.

Figures are here given of two of the modifications noted, the globose rm with long tubular projection (pl. 4, fig. 5) and the compressed rm (pl. 4, fig. 4) noted by Sidebottom.

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[1] Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, pl. 10, fig. 14.

### LAGENA HISPIDULA, new species.

Plate 5, figs. 2, 3.

*Lagena lævis* H. B. Brady (part) (not *L. lævis* (Montagu)), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 56, figs. 10, 11.

*Description.*—Test flask-shaped, broadly rounded at the base, abruptly narrowed above into a long tubular neck, whole surface very finely and evenly hispid; aperture rounded.

Length 0.60 to 0.95 mm.

*Distribution.*—This species occurred in the North Pacific material off the Hawaiian Islands, *Nero* station 2049 in 2,226 fathoms, off Japan, *Albatross* station D4950 in 529 fathoms, bottom temperature 38.9° F., in Gaspar Straits, North Pacific Exploring Expedition, Captain Rodgers, and at several *Nero* stations along the line of soundings between Yokohama and Japan, as follows: 1137 in 2,250 fathoms; 1160 in 1,907 fathoms; 1163 in 2,049 fathoms; 1209 in 660 fathoms; 1264 in 2,080 fathoms (type-locality); 1306 in 1,208 fathoms and 1310 in 518 fathoms.

*Type.*—Cat. No. 8526, U.S.N.M.

This species, which has been included in *Lagena lævis*, has a very characteristic form and is as far as I have observed invariably hispid. In fact in selected material this form has been taken out first with a low-power lens on account of form alone, and has always been found hispid when examined with a higher-power lens. It seems worthy of being separated from the smooth, more pyriform *L. lævis*.

### LAGENA AMPULLA-DISTOMA (Rymer-Jones).

### LAGENA AMPULLA-DISTOMA (Rymer-Jones), var. CRIBROSTOMOIDES, new variety.

Plate 4, fig. 3.

*Description.*—Like the typical, but the aperture a sieve-like plate, with numerous small rounded openings, apical end with numerous spines as well as the apical tubular projection.

Length 0.4 mm.

*Distribution.*—Type-specimen, Cat. No. 8527, U.S.N.M., from *Nero* station 1310 in 518 fathoms between Guam and Yokohama.

This variety shows a rather unusual type of aperture for this genus.

### LAGENA HYSTRIX Reuss.

Plate 5, fig. 5.

*Lagena hystrix* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 335, pl. 6, fig. 80.

*Lagena histrix* Terquem, Mem. Soc. Geol. France, ser. 3, vol. 2, 1882, p. 28, pl. 1 (9), fig. 14; ser. 3, vol. 4, 1886, p. 7, pl. 1, fig. 7.

*Description.*—Test flask-shaped, somewhat compressed, broadest at about the middle, neck short; surface with spine-like tubes, open at the end, intermediate spaces punctate.

Length 0.5 mm.

*Distribution.*—Specimens which from their peculiar surface ornamentation seem to belong to this species occurred off Japan, *Nero* station 1294 in 1,417 fathoms and *Albatross* H4878 in 84 fathoms, bottom temperature 51.9° F.

A figure is given showing the surface view of the tubulations. These are apparently not broken spines, as suggested by Brady, but are a definitely developed surface character in the test of this species.

### LAGENA PUNCTULATA, new species.

Plate 5, fig. 4.

*Description.*—Test flask-shaped, broadest below the middle, apical end rounded, apertural end gradually tapering to a short neck with a phialine lip; rounded in cross section; surface with an ornamentation consisting of an irregular series of large punctæ or fine pores, with the areas between finely punctate.

Length 0.4 mm.

*Distribution.*—Type-specimen, Cat. No. 8528, U.S.N.M., from *Albatross* station H4878 in 84 fathoms off Japan.

This species is perhaps related to *L. hystrix*, but the ornamentation consists of pores instead of spine-like tubulations.

### LAGENA ASPERA Reuss.

Plate 16, fig. 1.

*Lagena aspera* Reuss, Sitz. Akad. Wiss. Wien, vol. 44, 1861, p. 305, pl. 1, fig. 5; vol. 46, 1863, p. 335, pl. 6, fig. 81.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 457, pl. 57, figs. 7-10.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 337, pl. 14, figs. 10-12.—Chapman, Journ. Roy. Micr. Soc., 1893, p. 582, pl. 8, fig. 8.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 325, pl. 10, fig. 11.

*Description.*—Test flask-shaped, usually globular with a short stout neck, surface ornamented with an irregularly placed series of beadlike blunt spines.

Length 0.6 mm.

*Distribution.*—Brady records this species from two *Challenger* stations in the North Pacific in 2,050 and 2,300 fathoms. I have seen it but once, from *Nero* station 172 in 2,086 fathoms near the Midway Islands and 1463 in 951 fathoms near Guam.

In this specimen there is a tendency for the ornamentation on the neck to be linear in its arrangement and a definite phialine lip is present.

### LAGENA SQUAMOSA (Montagu).

Plate 6, fig. 1.

*Vermiculum squamosum* Montagu, Test. Brit., 1803, p. 526, pl. 14, fig. 2.

*Entosolenia squamosa* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, pl. 2, fig. 19; Rec. For. Great Britain, p. 12, pl. 1, fig. 29.

*Lagena squamosa* Brown, Ill. Rec. Conch. Great Britain, 1827, pl. 1, fig. 32.—Jones, Parker, and H. B. Brady, Mon. For. Crag, 1866, p. 39, pl. 4, fig. 7.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 471, pl. 58, figs.

### LAGENA HEXAGONA (Williamson).

Plate 6, figs. 2, 3.

*Entosolenia squamosa* Montagu, var. *hexagona* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 20, pl. 2, fig. 23; Rec. For. Great Britain, 1858, p. 13, pl. 1, fig. 31.

*Lagena hexagona* Siddall, Cat. Brit. Rec. For., 1879, p. 6.—Green, Amer. Journ. Micr., vol. 6, 1881, p. 46, pl., fig. 4.—H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 472, pl. 58, figs. 32, 33.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 326, pl. 10, fig. 60.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 17, pl. 2, fig. 3.

*Description.*—Test subglobular, broadly rounded at the apical end, bluntly pointed at the apertural end, surface ornamentation consisting of a reticulate pattern, the areoles of which are hexagonal, either arranged in vertical rows or irregular.

Length 0.25 to 0.50 mm.

*Distribution.*—I have had this species from the following North Pacific stations: *Nero* 1867 in 2,311 fathoms near the Midway Islands; 1603 in 1,733 fathoms and 1294 in 1,417 fathoms between Guam and Yokohama; and *Albatross* D4957 in 437 fathoms and D5054 in 282 fathoms off Japan.

In the specimens examined the arrangement of the reticulations seems usually to be very irregular, but occasionally it assumes vertical lines.

### LAGENA HEXAGONA (Williamson), var. SCALARIFORMIS (Williamson).

Plate 6, fig. 4.

*Entosolenia squamosa* (Montagu), var. *scalariformis* Williamson, Rec. For. Great Britain, 1858, p. 13, pl. 1, fig. 30.

*Lagena scalariformis* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 333, pl. 5, figs. 69–71.

*Description.*—Test similar in form to *L. hexagona* but differing in the surface ornamentation, which is elongate hexagonal, the vertical sides forming almost continuous costæ, the sides of the reticulations being thick.

Length 0.33 mm.

*Distribution.*—This form was noted at two North Pacific stations: *Tuscarora* 5, lat. 37° 04′ N.; long. 123° 22′ W., in 1,200 fathoms, and *Nero* station 201 in 1,033 fathoms near the Midway Islands.

### LAGENA FOVEOLATA Reuss.

Plate 7, fig. 3.

*Lagena foveolata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 332, pl. 5, fig. 65.—Millett, Journ. Roy. Micr. Soc., 1901, p. 11, pl. 1, fig. 15.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 395, pl. 16, fig. 15.

*Description.*—Test pyriform, broadest toward the base, broadly rounded at the apical end, gradually tapering to the slender neck at the apertural end, surface ornamentation consisting of longitudinal raised costæ, the furrows between divided transversely by less well-developed transverse costæ.

Length 0.25 mm.

*Distribution.*—Specimens occurred at three *Nero* stations between Guam and Yokohama; 1065 in 1,321 fathoms, 1128 in 1,418 fathoms, and 1301 in 1,088 fathoms. The coarser of these is here figured. The other is much finer in its sculpturing. Both specimens are closer to Reuss's figure than those given by either Millett or Sidebottom.

### LAGENA FOVEOLATA Reuss, var. PARADOXA Sidebottom.

Plate 15, fig. 3.

*Lagena foveolata* Reuss (?), var. *paradoxa* Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 395, pl. 16, figs. 22, 23.

*Description.*—Test flask-shaped, elongate, broad and rounded at the aboral end, tapering gradually toward the apertural end; neck short but definite; wall ornamented with longitudinal costæ running the entire length of the test, the inner costal furrows divided transversely by slightly raised lines and the whole furrow occupied by a double row of elongate, fine openings, outer wall tending to disintegrate and flake off, leaving the inner wall of the test exposed and spinose, the spines in longitudinal lines.

Length of North Pacific specimens 1.25 mm.

*Distribution.*—This variety was described from the southwest Pacific. This characteristic ornamentation and disintegration of the test is apparent in material from *Nero* station 2052 in 1,184 fathoms off the Hawaiian Islands.

evertheless the general character is the same, the transverse and ongitudinal costæ being practically of equal prominence and nearly t right angles with one another.

### LAGENA STRIATA (d'Orbigny).

Plate 7, figs. 4, 5.

*Oolina striata* D'ORBIGNY, Foram. Amér. Mérid., 1839, p. 21, pl. 5, fig. 12.
*Lagena striata* REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 327, pl. 3, figs, 44, 45; pl. 4, figs. 46, 47.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 460, pl. 57, figs. 22, 24.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 327, pl. 10, figs. 21-23.

*Description.*—Test flask-shaped, nearly circular in cross section, body of test subglobular, neck variable in length, usually rather abruptly contracted from the body of the test at its base, surface ornamented with numerous rather fine costæ running the entire length of the test, apical end typically broadly rounded, occasionally slightly tapering to a point.

Length 0.25 to 0.75 mm.

*Distribution.*—Bagg records this species from three *Albatross* stations: H4566 in 572 fathoms, H4567 in 1,307 fathoms, and H4694 in 865 fathoms off the Hawaiian Islands. I have had material from *Nero* station, 2049 in 2,226 fathoms off the Hawaiian Islands, 1309 in 891 fathoms between Guam and Yokohama, and at three *Albatross* stations—D4900 in 139 fathoms, D4958 in 405 fathoms, and D5056 in 258 fathoms, all off Japan.

There are many forms of striate Lagenæ, and it is very uncertain from the material I have had at my disposal where to draw lines of demarcation between forms. Unless there have been definite characters which have had some appearance of stability, I have preferred to place them under *L. striata*. Certain other forms have occurred in some numbers and have had rather definite characters, and for these certain names have been used to distinguish them here.

### LAGENA STRIATA (d'Orbigny), var. HAIDINGERI (Czjzek).

Plate 7, fig. 6.

*Oolina haidingeri* CZJZEK, Haidinger's Nat. Abhandl., vol. 2, 1847, p. 138, pl. 12, figs. 1, 2.
*Lagena haidingeri* REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 326, pl. 3, fig. 41.
*Lagena striata* H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 57, figs. 29, 30.—SIDEBOTTOM (part), Journ. Quekett Micr. Club, vol. 11, 1912, pl. 15, fig. 9.

*Description.*—Variety differing from typical *L. striata* in the neck, which is subconical with several prominent platelike costæ and the apical end with numerous short spines, usually curved outwardly.

Length 0.65 mm.

*Distribution.*—This variety was obtained at *Albatross* station, D2806 in 1,379 fathoms off the Galapagos Islands.

The two added characters of a fluted truncate conical neck with the basal outwardly curving spines seem to be correlated and the form worthy of recognition.

### LAGENA STRIATA (d'Orbigny), var. SUBSTRIATA Williamson.

Plate 8, figs. 1–3.

*Lagena substriata* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 15, pl. 2, fig. 12.

*Lagena vulgaris*, var. *substriata* Williamson, Rec. For. Great Britain, 1858, p. 7, pl. 1, fig. 14.

*Description.*—Variety differing from the typical in the more elongate body, long tapering neck, costulate surface extending up onto the neck often to its end and usually spirally arranged on the neck. Length 0.4–0.5 mm.

*Distribution.*—This variety seems to be much more common in the North Pacific than the others. It occurred at *Tuscarora* station 9 in lat. 31° 51′ N.; long. 119° 3′ W., in 980 fathoms. It has also occurred at numerous *Albatross* and *Nero* stations off Japan in depths ranging from 33 to 1,529 fathoms, but one station, however, being over a thousand fathoms.

### LAGENA STRIATA (d'Orbigny), var. STRUMOSA Reuss.

Plate 7, figs. 7–10.

*Lagena strumosa* Reuss, Zeitschr. geol. Ges., 1858, p. 434; Sitz. Akad. Wiss.

### LAGENA COSTATA Williamson.

Plate 9, fig. 6; plate 11, fig. 1; plate 12, fig. 1.

*Entosolenia costata* Williamson, Rec. For. Great Britain, 1858, p. 9, pl. 1, fig. 18.
*Lagena costata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 329, pl. 4, fig. 54.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 338, pl. 14, figs. 1–11.—Millett, Journ. Roy. Micr. Soc., 1901, p. 7, pl. 1, fig. 8.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 388, pl. 15, figs. 16–21.

*Description.*—Test subglobular, ornamented with a few rather remote ribs or costæ running nearly the length of the test, frequently not reaching the apex, but ending in a ring of spinose projections, aperture small and rounded; costæ most often rounded.

Length 0.25 to 0.50 mm.

*Distribution.*—I have had this species from *Nero* station 165 near the Midway Islands in 2.135 fathoms, between Guam and Yokohama, *Nero* stations 1065 in 1.321 fathoms, and 1306 in 1.208 fathoms, and *Albatross* station D4875 in 59 fathoms off Japan.

### LAGENA COSTATA Williamson, var. AMPHORA Reuss.

Plate 10, figs. 2, 3; plate 12, fig. 2.

*Lagena amphora* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 330, pl. 4, fig. 57.

*Description.*—Test elongate pyriform with a long tapering neck; surface with comparatively few, prominent costæ; aperture small, rounded.

Length 0.4–0.6 mm.

*Distribution.*—This variety was found at the following stations: *Tuscarora* 9, lat. 31° 51′ N.; long. 119° 3′ W., in 980 fathoms; *Tuscarora* 40, lat. 33° 41′ N.; long. 120° 50′ W., in 1,092 fathoms; *Nero* 542 in 1,996 fathoms between the Midway Islands and Guam; at several *Nero* stations between Guam and Yokohama at depths ranging from 891 to 1,632 fathoms; and two *Albatross* stations off Japan, D4825 in 120 fathoms and D4843 in 100 fathoms.

In this form there is much variation in the number of costæ and in the form as shown in the specimens here figured.

### LAGENA COSTATA (Williamson), var. POLYGONATA, new variety.

Plate 10, fig. 4.

*Description.*—Test subglobular, apertural end somewhat reduced, base truncate, polygonal in transverse section, angles reduced into longitudinal costæ; apical end with a polygonal depression at which the costæ end; aperture rounded.

Length 0.50 to 0.85 mm.

*Distribution.*—Type-specimen from *Nero* station 173 in 2,111 fathoms southeast of the Midway Islands. It also occurred at *Nero* station 1294 in 1,417 fathoms north of Guam.

*Type.*—Cat. No. 8529, U.S.N.M.

### LAGENA DISTOMA Parker and Jones.

Plate 13, figs. 1, 2.

*Lagena lævis* (Montagu), var. *striata* Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 278, pl. 11, fig. 24 (not *L. striata* (Walker and Boys)).

*Lagena distoma* Parker and Jones in H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 467, pl. 48, fig. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 461, pl. 58, figs. 11–15.—Egger, Abh. kön. bay. Wiss. München, Cl. ii, vol. 18, 1893, p. 330, pl. 10, fig. 13.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 53.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 5.

*Description.*—Test elongate subcylindrical or elongate fusiform, tapering at either end, wall longitudinally striate; translucent.

Length 1 to 2 mm.

*Distribution.*—Brady records this species in the North Pacific from a single *Challenger* station off Japan in 345 fathoms. Goës records it from the eastern Pacific in 782 to 1,132 fathoms. I have had material from three stations off Japan; *Nero* stations 1305 in 1,289 fathoms and 1309 in 891 fathoms; and *Albatross* D4843 in 100 fathoms, bottom temperature 39.9° F.

Except for its striate surface this species is very close to *L. elongata* (Ehrenberg).

### LAGENA SULCATA (Walker and Jacob).

Plate 9, fig. 2.

"Serpula (Lagena) striata sulcata rotundata" Walker and Boys, Test. Min., 1784, p. 2, pl. 1, fig. 6.

*Serpula* (*Lagena*) *sulcata* Walker and Jacob, Adams' Essays, Kanmacher's ed., 1798, p. 634, pl. 14, fig. 5.

### LAGENA SULCATA (Walker and Jacob), var. ALTICOSTATA, new variety.

Plate 9, fig. 5.

*Description.*—Test subglobular, ornamentation consisting of a few ominent primary costæ high, thin, and plate-like, running from e aperture to the apical end of the test; between these, secondary stæ running only to the base of the neck, the alternating ones of ese being shorter; aperture small, rounded.

Length 0.4 mm.

*Distribution.*—Type-specimen, Cat. No. 8530, U.S.N.M., from *Nero* ation 991 in 1,143 fathoms off Guam. It also occurred at *Nero* ation 1466 in 234 fathoms in the same vicinity.

### LAGENA SULCATA (Walker and Jacob), var. APICULATA, new variety.

Plate 9, figs. 3, 4.

*Lagena sulcata*, apiculate forms, H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 58, figs. 4, 17 (?).

*Description.*—Test like typical *L. sulcata*, but the apical end drawn out into a stout spine; aperture rounded.

Length 0.60–0.85 mm.

*Distribution.*—This variety occurred at *Nero* station 172 in 2,086 fathoms near the Midway Islands and at several *Nero* stations between Yokohama and Guam at depths ranging from 1,299 to 1,737 fathoms. It also occurred at two *Albatross* stations off Japan, D4807 in 44 fathoms and D5054 in 282 fathoms.

*Type-specimen.*—Cat. No. 8531, U.S.N.M., from *Nero* station 1440 n 1,737 fathoms.

### LAGENA ACUTICOSTA Reuss.

Plate 8, figs. 9, 10; plate 23, fig. 2.

*Lagena acuticosta* REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, 1861 (1862), p. 305, pl. 1, fig. 1; vol. 46, pt. 1, 1862 (1863), p. 331, pl. 5, fig. 63.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 464, pl. 57, figs. 31, 32; pl. 58, figs. 20 (?), 21.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 222, pl. 44, figs. 26, 31.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 329, pl. 10, figs. 47, 48, 82, 83.—SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 388, pl. 15, fig. 22.

*Description.*—Test subglobular to pyriform, broadest toward the ase and gradually tapering upward toward the apex; apertural end the test smooth and unornamented, lower portion with comparavely few, thin, much elevated costæ running to the apical end of ne test; aperture rounded.

Length 0.25 to 0.50 mm.

*Distribution.*—Brady mentions the occurrence of this species in the orth Pacific. From the material I have been able to examine the species seems to be well distributed in the area, occurring at the following stations: *Albatross* H4857 in 324 fathoms in Bering Sea; H2922 in 268 fathoms off the Hawaiian Islands; *Nero* 991 in 1,143 fathoms off Guam; *Nero* 862 in 1,550 fathoms off Luzon; *Nero* 1160 in 1,907 fathoms between Guam and Yokohama; and two *Albatross* stations off Japan, H4878 in 84 fathoms and D4975 in 712 fathoms.

### LAGENA ACUTICOSTA Reuss, var. PAUCICOSTATA, new variety.

Plate 9, fig. 1.

*Lagena acuticosta* SIDEBOTTOM (part), Journ. Quekett Micr. Club, vol. 11, 1912, p. 388, pl. 15, fig. 23 (not fig. 22).

*Description.*—Test more globular than in the typical, the costæ reduced to three, remaining portion of the test smooth; aperture very small, rounded.

Length 0.33 mm.

*Distribution.*—Type-specimen, Cat. No. 8532, U.S.N.M., from *Albatross* station D4887, in 71 fathoms off Japan.

This agrees well with the variety figured by Sidebottom as noted above, the three costæ forming the whole of the ornamentation of the test. In our specimen the costæ do not continue to the apertural end, though they do in the specimen figured by Sidebottom.

### LAGENA GRACILIS Williamson.

Plate 8, figs. 5, 6.

*Lagena gracilis* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 13, pl. 1, figs. 3, 4.—REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 2, 1862 (1863), p.

### LAGENA GRACILIS Williamson, var.

Plate 8, fig. 7.

*Description.*—Test elongate, the body of the test with numerous costæ, the apertural end with comparatively few, plate-like costæ independent of the costæ of the body.

Length 0.4 mm.

*Distribution.*—Figured specimen from *Nero* station 1294 in 1,417 fathoms between Guam and Yokohama.

### LAGENA INFEROCOSTATA, new species.

Plate 8, fig. 8.

*Description.*—Test elongate, subcylindrical or fusiform, central portion with nearly parallel sides, abruptly pointed at either end; lower portion costate, the coarse costæ meeting in a ring at the base of the test; upper portion of test without costæ, nearly smooth except for a reticulation of irregularly placed depressions; aperture circular, without a definite neck.

Length 0.35 mm.

*Distribution.*—Type-specimen, Cat. No. 8533, U.S.N.M., from *Nero* station 1073 in 1,208 fathoms between Yokohama and Guam.

This species is remotely related to *L. acuticosta* in some of its characters.

### LAGENA MUCRONULATA Reuss.

Plate 8, fig. 4.

*Lagena mucronulata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 329, pl. 4, fig. 52.

*Description.*—Test fusiform, the apical end tapering into a short spinose projection; the apertural end with a short neck ending in a subglobular portion, the neck below being somewhat annular, surface ornamented with a few coarse costæ extending from a rim below the neck to the apical end.

Length 0.5 mm.

*Distribution.*—This species was found at *Nero* station 1064 between Guam and Yokohama in 1,588 fathoms.

The peculiar form of the test and the shape of the apertural end of the neck seem to be distinctive features.

### LAGENA PLUMIGERA H. B. Brady.

Plate 12, fig. 4.

*Lagena plumigera* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 62; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 465, pl. 58, figs. 25, 27.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 329, pl. 10, figs. 37, 38.—Millett, Journ. Roy. Micr. Soc., 1901, p. 490, pl. 8, fig. 8.

*Description.*—Test flask-shaped, broadest near the base tapering to a long slender neck; wall ornamented with seven to twelve longitudinal costæ, plate-like at the aboral end of the test spreading into wing-like expansions showing transverse striations.

Length 0.60 to 0.75 mm.

*Distribution.*—This species does not seem to have been previously reported from the North Pacific. Typical specimens were obtained in material from two *Nero* stations; 1117 in 2,123 fathoms and 1294 in 1,417 fathoms, between Yokohama and Guam.

Nearly all the records for the distribution of this species are in deep water and these two are no exceptions to the rule. Most of the stations are in tropical or subtropical waters but the depth at which the species has occurred precludes any influence of temperature in the distribution.

### LAGENA STELLIGERA H. B. Brady.

Plate 12, fig. 3.

*Lagena stelligera* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 60; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 466, pl. 57, figs. 35, 36.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 391, pl. 15, figs. 28, 29; pl. 16, figs. 1–4.

*Description.*—Test pyriform, broadest near the middle, tapering toward the truncate base and toward the obtusely pointed apertural end; aboral end of the test with a central raised circular rim from the periphery of which radiate eight to twelve short acute costæ extending a short distance up the basal portion of the test; wall smooth above or with slight crenulations about the aperture; the wall about the neck often with darker concentric circles of a slightly darker color.

Length 0.5 to 0.8 mm.

*Distribution.*—Type-specimens, Cat. No. 8534, U.S.N.M., from *Tuscarora* station 23, lat. 21° 40′ N.; long. 179° 20′ E., in 1,964 fathoms.

The ornamentation of this species is a peculiar one composed of the prominent oval ring and the irregular broken costæ of the rest of the test.

### LAGENA STRIATO-AREOLATA Rymer-Jones.

Plate 14, figs. 5, 6.

*Lagena vulgaris* Williamson, var. *striato-areolata* Rymer-Jones, Trans. Linn. Soc., London, vol. 30, 1872, p. 53, pl. 19, figs. 21, 21*a*.

*Lagena striato-areolata* Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 390, pl. 15, fig. 27.

*Description.*—Test flask-shaped, neck long and slender, upper portion of test with four costæ becoming tubular or punctate below, intermediate portion composed of an irregular, generally hexagonal, net-work.

Length 0.5 mm.

*Distribution.*—The single specimen, which compares very favorably with the figure given by Sidebottom noted above, is from *Nero* station 172 in 2,086 fathoms, between the Hawaiian and Midway Islands.

### LAGENA TORQUATA H. B. Brady.

Plate 11, fig. 3.

*Lagena torquata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 62; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 469, pl. 58, fig. 41.

*Description.*—Test flask-shaped, neck long and slender, surface of test with a series of prominent primary longitudinal costæ with punctæ or tubulations down the middle of each, between each pair of primary costæ secondary costæ, imperforate, shorter and less prominent, and transversely finer ribs, breaking the whole up into a reticulate pattern.

Length 0.50 to 0.75 mm.

*Distribution.*—The only station at which this form occurred in the North Pacific material is *Nero* station 1122 in 1,926 fathoms, between Yokohama and Guam.

This species is close to *L. desmophora* and represents a higher development of the surface ornamentation in the transverse ribs and consequent reticulation of the surface.

### LAGENA DESMOPHORA Rymer-Jones.

Plate 12, fig. 5; plate 13, fig. 3.

*Lagena vulgaris* Williamson, var. *desmophora* Rymer-Jones, Trans. Linn. Soc. London, vol. 30, 1872, p. 54, pl. 19, figs. 23, 24.

*Lagena desmophora* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 468, pl. 58, figs. 42, 43.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 394.

*Description.*—Test flask-shaped, neck long and slender, surface ornamented with several longitudinal, primary costæ with tubulations, between which are usually secondary costæ, solid and nontubulated, aboral end with or without a spine or series of spines at the ends of the primary costæ.

Length 0.60 to 0.85 mm.

*Distribution.*—Brady records this species from a single North Pacific *Challenger* station in 1,850 fathoms. I have had specimens from several *Nero* stations; one between the Hawaiian and Midway Islands, 165 in 2,135 fathoms and the following stations in the lines of soundings between Guam and Yokohama; 1063 in 1,884 fathoms; 1145 in 2,119 fathoms; 1158 in 1,584 fathoms; 1301 in 1,088 fathoms; 1312 in 1,552 fathoms and 1323 in 1,583 fathoms.

The more simple of the specimens here figured may be perhaps closely related to *L. striato-punctata* in that it lacks the secondary costæ, but those costæ which are present are decidedly catenulate in character and I have included it here.

### LAGENA EXSCULPTA H. B. Brady.

Plate 13, fig. 5.

*Lagenulina sulcata* TERQUEM (not *Lagena sulcata* (Walker and Jacob)), Essai Animaux plage Dunkerque, pt. 2, 1876, p. 68, pl. 7, fig. 9.

*Lagena exsculpta* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 467, pl. 58, fig. 1; pl. 61, fig. 5.—SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 392.

*Description.*—Test subglobular or pyriform, rounded or compressed, apertural half of test smooth and unornamented, aboral half ornamented with numerous costæ, not raised above the surface of the

### LAGENA INTERMEDIA Sidebottom.

Plate 13, fig. 4.

*Lagena semistriata?* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 465, pl. 57, fig. 20.

*Lagena intermedia* Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 399, pl. 17, figs. 1–3.

*Description.*—Test pyriform, broadest near the base, circular in cross section; surface smooth, except the basal portion, which has an irregular series of costæ radiating from the center of the base; aperture fissurine.

Length 0.5 mm.

*Distribution.*—This species has occurred at but a single station, *Nero* 1163 in 2,049 fathoms between Guam and Yokohama.

This agrees very closely with some of the figures given by Sidebottom and with the figure in the *Challenger* Report, but the specimen here figured has also a secondary apical radiating group of costæ below the rim. In this regard this specimen is almost intermediate between the rounded specimens of *L. exsculpta* and *L. intermedia.* However, in its general characters this seems decidedly to belong to *L. intermedia.*

### LAGENA FEILDENIANA H. B. Brady.

Plate 15, figs. 1, 2.

*Lagena feildeniana* H. B. Brady, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 434, pl. 20, fig. 4; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 469, pl. 58, figs. 38, 39.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 328, pl. 10, fig. 100.

*Description.*—Test elongate, ovate, broad and rounded at the aboral end, tapering nearly to a point at the apertural end; surface ornamentation made up of numerous acute raised costæ running longitudinally the entire length of the test, the surface between consisting of longitudinal furrows each with a series of perforations, each in a slight depression and ovate in shape, the narrow end toward the apertural end of the test.

Length about 1 mm.

*Distribution.*—Brady records this species in the North Pacific from a single *Challenger* station in 2,300 fathoms. I have had it from a single *Albatross* station, D5085, in Sagami Bay, Hondo, Japan, in 622 fathoms, bottom temperature 37.8° F.

With a high-power lens to bring out the details of the ornamentation this is one of the most beautiful species of *Lagena.* The ornamentation is simple, but the delicacy of the sculpturing is really beautiful. This seems to be described by Sidebottom.[1] as *Lagena hertwigiana* H. B. Brady, var. *undulata* Sidebottom.

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[1] Journ. Quekett Micr. Club, vol. 11, 1912, p. 397, pl. 16, figs. 26–28.

### LAGENA STRIATO-PUNCTATA Parker and Jones.

Plate 14, fig. 10.

*Lagena sulcata*, var. *striato-punctata* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 350, pl. 13, figs. 25–27.

*Entosolenia striato-punctata* G. M. Dawson, Can. Nat., vol. 5, 1870, p. 178, woodcut, p. 180, fig. 11.

*Lagena striato-punctata* H. B. Brady, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 434, pl. 20, fig. 3; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 468, pl. 58, figs. 37, 40.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 339, pl. 14, fig. 20.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 327, pl. 10, figs. 35, 36, 44–46.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 83, pl. 13, fig. 753.—Millett, Journ. Roy. Micr. Soc., 1901, p. 489, pl. 8, fig. 6.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 17, pl. 2, fig. 5; Journ. Quekett Micr. Club, vol. 11, 1912, p. 392, pl. 16, figs. 7-10.

*Description.*—"Test oval pyriform, or flask-shaped, and either ecto- or entosolenian. It is decorated externally with tolerably stout longitudinal costæ, from 6 to 20 in number, bearing conspicuous pseudopodial foramina. The perforations are placed either in single rows down the middle of the costæ, or in double lines, one on each side, in their thickened bases."

Length 0.3 mm.

*Distribution.*—Brady records this species from *Challenger* station 241 in 2,300 fathoms.

### LAGENA FIMBRIATA H. B. Brady.

Plate 14, fig. 8.

*Lagena fimbriata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep.

### LAGENA STAPHYLLEARIA (Schwager).

Plate 17, fig. 3.

*Fissurina staphyllearia* SCHWAGER, *Novara*-Exped., Geol. Theil, vol. 2, 1866, p. 209, pl. 5, fig. 24.

*Lagena staphyllearia* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 474, pl. 59, figs. 8–11.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 331, pl. 10, figs. 50, 51, 99.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 307, pl. 54, fig. 1.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 619, pl. 14, fig. 2.—SIDEBOTTOM, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 8, pl. 1, figs. 18–20; Journ. Quekett Micr. Soc., vol. 11, 1912, p. 403, pl. 17, figs. 19–24.

*Lagena vulgaris*, var. *spinicosto-marginata* RYMER-JONES, Trans. Linn. Soc. London, vol. 30, 1872, p. 57, pl. 19, figs. 34–36.

*Description.*—Test ovate, compressed, wall smooth, periphery keeled usually, with several spines symmetrically arranged about the border; aperture fissurine.

Length about 0.5 mm.

*Distribution.*—Apparently this species has not previously been recorded from the North Pacific. It has occurred at three *Nero* stations; 91 in 1,983 fathoms and 170 in 1,990 fathoms between the Hawaiian and Midway Islands and 862 in 1,550 fathoms off Luzon, Philippine Islands.

Both three- and five-spined specimens occur, but the range of variation shown by Sidebottom does not seem to exist in our specimens. The figured specimen is very similar to the one figured by Sidebottom as *Lagena fasciata* Egger, var. *spinosa* Sidebottom,[1] but our specimen lacks the ornamentation of *L. fasciata*. Otherwise the two are very similar.

### LAGENA TRUNCATA H. B. Brady.

Plate 19, fig. 3.

*Lagena truncata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 457, pl. 56, figs. 31, 32.

*Description.*—Test elongate, pyriform: greatest breadth below the middle, aboral end broadly rounded; apertural end obtusely rounded; wall smooth; aboral end with two or more short spines; aperture radiate.

Length 0.4 to 1.0 mm.

*Distribution.*—This species occurred in material from *Nero* station 1065 in 1,321 fathoms between Guam and Yokohama.

Brady speaks of the aperture as "either round or fissurine" but the specimen figured has a decidedly radiate aperture. The optical section gives the form and comparative length of the entosolenian tube.

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[1] Journ. Quekett Micr. Club, vol. 11, 1912, p. 402, pl. 17, fig. 17.

### LAGENA UNGUICULATA H. B. Brady.

Plate 11, fig. 1.

*Lagena unguiculata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 474, pl. 59, fig. 12.

*Description.*—"Test pyriform, compressed; inferior end broad and tapering to a thin edge, which is furnished with a number of more or less curved teeth symmetrically set."

Length 0.35 mm.

*Distribution.*—On page 876 of the volume on the "Summary of Results of the Challenger Report," this species is recorded from station 224 in 1,850 fathoms.

This seems to be the only North Pacific record.

### LAGENA AURICULATA H. B. Brady, var. COSTATA H. B. Brady.

Plate 14, fig. 2.

*Lagena auriculata* H. B. Brady, var. *costata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 487, pl. 60, fig. 38.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 422, pl. 20, figs. 21, 22.

*Description.*—Variety with the body of the test costate and also carinate.

Length 0.25 mm.

*Distribution.*—Brady records this species from a single *Challenger* station in the North Pacific in 2,300 fathoms.

The figure is from the *Challenger* Report

### LAGENA AURICULATA H. B. Brady, var. LINEARITUBA, new variety.

Plate 17, fig. 5.

*Lagena auriculata* H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 487, pl. 60, fig. 31.

*Description.*—Test elongate, ovate, broadest below the middle, apical end broadly rounded, apertural end gradually tapering to an obtuse point; surface smooth, lateral tubulations much elongated and very shallow; aperture radiate.

Length 0.5 mm.

*Distribution.*—Type-specimen, Cat. No. 8536, U.S.N.M., from *Nero* station 1294 between Guam and Yokohama in 1,417 fathoms

This is the form referred by Brady to this species with a question.

### LAGENA ALVEOLATA H. B. Brady.

Plate 18, fig. 1.

*Lagena alveolata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 487, pl. 60, figs. 30, 32.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 15, pl. 2, fig. 17; Journ. Quekett Micr. Club, vol. 11, 1912, p. 424, pl. 21, figs. 1, 2.

*Description.*—"Test pyriform compressed, lateral edges obtuse or rounded; base broad and round in outline, rarely mucronate; furnished with a median and two lateral carinae, which unite so as to form two loops on each side of the test, usually separated by a central depression."

Length 0.3 to 0.5 mm.

*Distribution.*—Brady records this species from a single station in the North Pacific in 2,300 fathoms. I have had the typical form from three *Nero* stations between Guam and Yokohama; 1065 in 1,321 fathoms, 1155 in 1,632 fathoms and 1440 in 1,737 fathoms.

The species seems to occur nearly always in deep water as noted by Brady. This typical form of the species is small, the test subtransparent, the loops entirely at the sides, very different from the following.

### LAGENA ALVEOLATA H. B. Brady, var. PLEBEIA, new variety.

Plate 18, fig. 2.

*Description.*—Test larger than the typical, coarser, opaque, walls thick, the three keels separated from one another, forming two gaping depressions at either side of the median keel, margins roughened, apertural end much like the typical.

Length 0.5 to 0.9 mm.

*Distribution.*—This form is by far the most common of the species in the North Pacific. It occurred at *Nero* station 170 in 1,990 fathoms, southeast of the Midway Islands, and at 10 stations between Guam and Yokohama, in depths varying from 1,040 to 2,250 fathoms.

*Type-specimen.*—Cat. No. 8537, U.S.N.M., from *Nero* station 1160 in 1,907 fathoms. It also occurred at *Tuscarora* station 2 in lat. 21° 07′ N.; long. 158° 14′ W. in 1,468 fathoms.

### LAGENA ALVEOLATA H. B. Brady, var. SUBSTRIATA H. B. Brady.

Plate 18, fig. 5.

*Lagena auriculata* H. B. Brady, var. *substriata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61.

*Lagena alveolata* H. B. Brady, var. *substriata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 488, pl. 60, fig. 34.—Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 424.

*Description.*—Variety characterized by the body portion of the test being striate or costate, especially about the base and somewhat less so toward the apertural end.

Length 0.60 mm.

*Distribution.*—I have had specimens of this variety from *Tuscarora* station 5, lat. 37° 04′ N.; long. 123° 22′ W., in 1,200 fathoms and from four *Nero* stations between Guam and Yokohama as follows: 1299 in 1,817 fathoms, 1301 in 1,088 fathoms, 1320 in 2,048 fathoms, and 1324 in 1,915 fathoms.

The basal costæ in this variety seem not to extend up beyond the lower half of the test.

### LAGENA ALVEOLATA H. B. Brady, var. BASIEXCAVATA, new variety.

Plate 18, fig. 4.

*Description.*—Variety characterized by two costæ on each side in

### LAGENA QUADRATA (Williamson).

Plate 14, fig. 9.

*Entosolenia marginata*, var. *quadrata* Williamson, Rec. Foram. Great Britain, 1858, p. 11, pl. 1, figs. 27, 28.

*Lagena lucida*, var. *quadrata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 324, pl. 2, fig. 26.

*Lagena quadrata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 475, pl. 59, figs. 3, 16.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 331, pl. 10, figs. 78, 79.—Millett, Journ. Roy. Micr. Soc., 1901, p. 496, pl. 8, fig. 18.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 8, pl. 1, figs. 21, 22; pl. 2, figs. 1–3.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 142.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 18, pl. 2, fig. 8 [?]; Journ. Quekett Micr. Club, vol. 11, 1912, p. 405, pl. 17, figs. 26–28 [?].

*Description.*—Test compressed, somewhat quadrate in outline, usually somewhat keeled, aperture somewhat elongate, wall smooth.

Length 0.5 mm.

*Distribution.*—Bagg records this species from *Albatross* stations H4440 in 1,259 fathoms and H4694 in 865 fathoms off the Hawaiian Islands. I have had the typical form only from *Nero* station 1208 in 665 fathoms between Guam and Yokohama.

### LAGENA QUADRATA (Williamson), var. RIZZÆ (Seguenza).

Plate 19, fig. 4.

*Fissurina rizzæ* Seguenza, Foram. monotal. Mioc. Messina, 1862, p. 72, pl. 2, fig. 50.

*Lagena quadrata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 475, pl. 60, fig. 5.

*Description.*—Test subquadrate, compressed, central portion smooth, each side with a peripheral carina just back from the edge of the test, neck short, aperture with a broad phialine lip.

Length 0.5 mm.

*Distribution.*—This variety occurred at two *Nero* stations 1464 in 891 fathoms near Guam and 1310 in 518 fathoms between Guam and Japan.

This is close to the form figured by Brady in the *Challenger* report and seems near enough to the above form described by Seguenza to warrant the use of his name for it.

### LAGENA QUADRICOSTULATA Reuss.

Plate 14, fig. 1.

*Lagena quadricostulata* Reuss, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 469.—Schlicht, Foram. Pietzpuhl, 1870, pl. 4, figs. 25–30.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 486, pl. 59, figs. 7(?), 15.

*Description.*—"Test pyriform and more or less compressed, the margin obtuse or rounded, the base frequently mucronate, and the aperture entosolenian; the surface bears four arched costæ, two on each face of the test, near the lateral margins and parallel to them.

The costæ are thickest near the middle, and taper away toward the ends."

Length 0.25 mm.

*Distribution.*—In the volumes on the "Summary of Results of the *Challenger* Expedition" this species is recorded on page 965 from station 246 in 2,050 fathoms, and on page 937 recorded with a question from station 237. In many respects this is close to *L. fasciata* Egger.

### LAGENA LUCIDA (Williamson).

*Entosolenia marginata*, var. *lucida* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 17, pl. 2, fig. 17.

*Lagena lucida* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862 (1863), p. 324, pl. 2, figs. 25, 26.—Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 80, pl. 2, fig. 7; pl. 3, figs. 4, 5.—Millett, Journ. Roy. Micr. Soc., 1901, p. 494.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 6, pl. 1, figs. 9–12; vol. 54, No. 16, 1910, p. 17, pl. 2, fig. 7; Journ. Quekett Micr. Club, vol. 11, 1912, p. 401, pl. 17, figs. 12–14.

*Description.*—Test somewhat compressed, marginal portion and central area clear and translucent, with a rather broad more or less opaque band between, wall smooth, aperture usually fissurine or rounded.

Length 0.3 to 0.8 mm.

*Distribution.*—At three North Pacific stations excellent specimens of this species were found, *Nero* station 1464 in 891 fathoms off Guam; 1129 in 1,505 fathoms southeast of Japan; and *Albatross* H4881 in 316 fathoms off Japan.

The specimens vary much in outline, one being very truncate and broad at the apertural end, others rounded.

*Description.*—Test more or less compressed, each side of the body portion with a curved band, usually hollowed somewhat into the surface of the test, the periphery of the test with a keel, surface otherwise smooth.

Length 0.35 to 0.85 mm.

*Distribution.*—This variety occurred at several *Nero* stations in the vicinity of the Hawaiian Islands at depths ranging from 22 to 2,098 fathoms; between Guam and Yokohama at several *Nero* stations ranging in depth from 1,417 to 1,817 fathoms; at two *Albatross* stations off Japan, D4825, in 120 fathoms, and H4878, in 84 fathoms, and two *Tuscarora* stations; 28 in lat. 35° 15′ N.; long. 120° 58′ W., in 65 fathoms, and 47 in lat. 24° 20′ N.; long. 154° 06′ E., in 1,499 fathoms.

### LAGENA SEMINIFORMIS Schwager.

Plate 11, fig. 2.

*Lagena seminiformis* Schwager, *Novara* Exped., Geol. Theil., vol. 2, 1866, p. 208, pl. 5, fig. 21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 478, pl. 59, figs. 28–30.

*Lagena marginata*, var. *seminiformis* Millett, Journ. Roy. Micr. Soc., 1901, p. 620, pl. 14, fig. 3.

*Description.*—Test circular or ovate in front view, with a comparatively long tubular neck, whole surrounded by a wide, thin peripheral keel, extended at each side of the base into long pointed projections; wall smooth.

Length up to 1.26 mm.

*Distribution.*—Brady records this species from a single North Pacific station, *Challenger*, 224 in 1,850 fathoms.

### LAGENA MARGINATA (Walker and Boys).

Plate 22, figs. 1–7.

*Serpula (Lagena) marginata* Walker and Boys, Test. Min., 1784, p. 2, pl. 1, fig. 7.

*Vermiculum marginatum* Montagu, Test. Brit., 1803, p. 524.

*Entosolenia marginata* Williamson (part), Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 17, pl. 2, figs. 15–17.

*Lagena marginata* Brown, Illus. Conch. Great Britain, 1827, pl. 1, figs. 30, 31.—Reuss, Sitz. Acad. Wiss. Wien, vol. 46, 1862 (1863), p. 322, pl. 2, figs. 22*a*, *b*, 23*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 476, pl. 59, figs. 21–23.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 222, pl. 44, figs. 27, 29, 30, 32.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 332, pl. 10, figs. 20, 66, 67, 96, 97.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 81, pl. 13, fig. 748; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 52.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 307, pl. 54, fig. 2.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 405, pl. 17, figs. 29–31; pl. 18, figs. 1–3.

*Description.*—Test more or less compressed, rounded in front view, wall smooth, bordered by a peripheral keel of greater or less width, solid or with radiating tubuli, aperture usually fissurine.

Length 0.25 to 1.50 mm.

*Distribution.*—This species in its various modifications is common in the North Pacific. Goës records it from the eastern Pacific in 695 to 1,201 fathoms and Bagg from four *Albatross* stations in the vicinity of the Hawaiian Islands, D4017, D4174, H4430, and H4696, in 305, 735–865, 1,544, and 367 fathoms, respectively. I have seen specimens from *Nero* station 172 in 2,086 fathoms near the Midway Islands, *Albatross* H3007 in 323 fathoms near the Hawaiian Islands, from over 25 *Nero* stations between Guam and Yokohama at depths ranging from 518 to 2,250 fathoms, from three *Albatross* stations off Japan, D4843, D4875, and D4953, in 100, 59, and 1,350 fathoms, respectively. It also occurred at two *Tuscarora* stations, 47 in lat. 24° 20′ N.; long. 154° 06′ E., in 1,499 fathoms, and 58 in lat. 26° 52′ N.; long. 142° 21′ E., in 814 fathoms.

There is much variation in the comparative breadth and the character of the keel and in the amount of compression of the test and in the size of various specimens.

### LAGENA MARGINATA (Walker and Boys), var.

Plate 21, fig. 2.

*Description.*—Test with a thin peripheral keel, broadest toward the base and sides, slightly emarginate below and gradually decreasing in width toward the apertural end, where it ceases entirely, leaving the upper third of the test noncarinate.

Length 0.75 mm.

*Distribution.*—Found at three stations between Guam and Yoko-

### LAGENA LAGENOIDES (Williamson).

Plate 16, fig. 2.

*Entosolenia marginata* Walker and Boys, var. *lagenoides* Williamson, Rec. Foram. Great Britain, 1858, p. 11, pl. 1, figs. 25, 26.

*Lagena lagenoides* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p. 324, pl. 2, figs. 27, 28.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 479, pl. 60, figs. 6, 8, 9, 12.—Millett, Journ. Roy. Micr. Soc., 1901, p. 623, pl. 14, fig. 8.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 411, pl. 18, figs. 22-28.

*Description.*—Test flask-shaped, usually compressed, body oval or ovate, surrounded by a simple peripheral keel which has numerous radiating tubulations, neck usually comparatively short, in complete specimens usually joined with the peripheral keel.

Length 0.4 to 1 mm.

*Distribution.*—The single *Albatross* station, H4566, in 572 fathoms off the Hawaiian Islands, seems to be the only record for this species in the North Pacific. I have a single specimen, here figured, from *Nero* station 1310 in 518 fathoms, between Yokohama and Guam.

There are apparently various modifications of the tubulated keeled Lagenas and from the North Pacific material at least two which may be definitely distinguished. Therefore I have here restricted the use of the name to those specimens which have a peripheral keel, which in its unbroken condition extends entirely about the periphery of the test, is rather remotely tubulated, the neck usually seeming a portion of the keel, comparatively short, usually the keel not emarginate but entire.

### LAGENA LAGENOIDES (Williamson), var. TENUISTRIATA H. B. Brady.

Plate 16, fig. 3.

*Lagena tubulifera* H. B. Brady, var. *tenuistriata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61.

*Lagena lagenoides* Williamson, var. *tenuistriata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 479, pl. 60, fig. 11 (not 15, 16).—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 12, pl. 2, figs. 9, 10; Journ. Quekett Micr. Club, vol. 11, 1912, p. 413, pl. 19, figs. 4, 5.

*Description.*—Test flask-shaped, pyriform, keel with comparatively few, large, remote tubulations; body of test not greatly compressed; surface ornamented with coarse longitudinal costæ running the length of the body of the test.

Length 0.35 to 0.50 mm.

*Distribution.*—This restricted varietal form has occurred at four stations in the *Nero* material at one station; 542 in 1,996 fathoms between Midway Islands and Guam and three stations; 1137 in 2,250 fathoms; 1160 in 1,907 fathoms, and 1287 in 1,606 fathoms between Guam and Yokohama.

In the *Challenger* report under this variety Brady figures what seem from a study of the North Pacific material to be two distinct forms. In plate 60, figure 11, is given a figure of a specimen which in its essential characters is very similar to the specimen figured here, plate 16, figure 3. On plate 60, figures 15, 16 are figured specimens with a very wide keel with numerous fine tubulations and the surface ornamented with very fine striations instead of costæ. I find in the North Pacific material that this distinction is met with in all the specimens examined, and I have included under Brady's var. *tenuistriata* such specimens as are figured here and selected by Sidebottom in his figures above referred to. The other form is placed under the following species.

### LAGENA SUBLAGENOIDES, new species.

Plate 16, fig. 4.

*Lagena lagenoides* (part) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 479, pl. 60, figs. 13, 14.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, fig. 23.—Millett, Journ. Roy. Micr. Soc., 1901, p. 623, pl. 14, fig. 9 [?]

*Description.*—Test flask-shaped, much compressed, central body of test elongate ovate tapering into a long, slender neck, surrounded by a wide peripheral keel with numerous close-set, fine tubulations, central portion smooth, apical end of keel usually but not always emarginate.

Length 0.60 to 0.85 mm.

*Distribution.*—This, like *L. formosa* Schwager, seems to be a deep-water species. It was found at three North Pacific stations; *Albatross* D2806 in 1,379 fathoms off the Galapagos Islands; *Nero* north of Guam. It also occurred at three other *Nero* stations; 1439 in 1,901 fathoms also north of Guam; 1691 in 1,912 fathoms between Guam and the Midway Islands, and 166 in 1,850 fathoms between the Midway and Hawaiian Islands.

This variety is characterized by very fine, often slightly wavy longitudinal striæ, a type of ornamentation which seems to go with the broad keel with fine tubulations.

### LAGENA FORMOSA Schwager.

Plate 11, fig. 6.

*Lagena formosa* SCHWAGER (part), *Novara* Exped., Geol. Theil, vol. 2, 1886, p. 207, pl. 4, figs. 19*a*, 19*d* (not 19*b*, 19*c*).—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 480, pl. 60, figs. 10, 18–20.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 53.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 624, pl. 14, figs. 10–12.—SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 414, pl. 19, figs. 6–9.

*Lagena lagenoides* EGGER (not Williamson), Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 335, pl. 10, fig. 85.

*Description.*—Test flask-shaped, compressed, body of test elongate oval, with a long, tapering, slender neck, the central portion of the test immediately surrounded on either side by a raised edge outside of which peripherally is a broad keel with radiating fine tubulations; apertural and apical ends of the central portion of the test passing into the inner keel by a series of interrupted costæ, apical end of peripheral keel usually emarginate.

Length up to 1 mm. or more.

*Distribution.*—Brady records this species from two *Challenger* stations in the North Pacific, in 1,850 and 2,575 fathoms. Goës records it from *Albatross* station 3399 in the eastern Pacific in 1,740 fathoms. I have found this species to be fairly common in the *Nero* material from the region between Guam and Yokohama, mostly in comparatively deep water, the depths varying from 1,417 to 2,119 fathoms. It occurred near Guam at *Nero* station 1464 in 891 fathoms; near the Midway Islands, *Nero* station 170 in 1,990 fathoms; station 91 in 1,983 fathoms and off the Hawaiian Islands, *Nero* station 10 in 2,098 fathoms.

This is a large and beautifully ornamented species. It seems to be widely distributed in deep water.

### LAGENA FORMOSA Schwager, var. FAVOSA H. B. Brady.

Plate 11, fig. 7.

*Lagena formosa* SCHWAGER, var. *favosa* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 480, pl. 60, fig. 21.

*Description.*—Variety differing from the typical in having two or three rows of reticulate ornamentation between the body of the test and the peripheral wing.

Length 1 mm.

*Distribution.*—Described by Brady in the *Challenger* report from *Challenger* station 224 in 1,850 fathoms in the western part of the North Pacific.

### LAGENA FORMOSA Schwager, var. COMATA H. B. Brady.

Plate 11, fig. 8.

*Lagena formosa* SCHWAGER, var. *comata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 480, pl. 60, fig. 22.

*Description.*—Variety differing from the typical in having the body of the test striate and the periphery and base of the neck reticulate.

Length 0.85 mm.

*Distribution.*—This variety was described by Brady from *Challenger* station 224 in 1,850 fathoms in the western part of the North Pacific. The only North Pacific station from which I have seen this variety is *Nero* 1464 in 891 fathoms.

### LAGENA BICARINATA Terquem, var. LATEROCOSTATA, new variety.

*Description.*—Test compressed, ovate in front view, periphery of test concave with a keel at either side, on each side of the body portion posteriorly a short, curved, prominent costa, remainder of body surface smooth.

Length 0.4 mm.

*Distribution.*—Type-specimen Cat. No. 8553, U.S.N.M., from *Nero* station 1012 in 1,932 fathoms north of Guam.

### LAGENA ORBIGNYANA (Seguenza).

*Distribution.*—Goës records the elongate form of this species from *Albatross* stations in the eastern Pacific in 1,132 to 1,201 fathoms. I have had specimens from *Nero* station 2049 in 2,226 fathoms off the Hawaiian Islands and from numerous stations between Guam and Yokohama, depths ranging from 688 to 1,907 fathoms. It also occurred at two *Albatross* stations off Japan, D4957 in 437 fathoms and D4975 in 712 fathoms.

The elongate form here figured has occurred much more frequently than the rounded form.

### LAGENA ORBIGNYANA (Seguenza), var. LACUNATA (Burrows and Holland).

Plate 20, fig. 1.

*Lagena castrensis* H. B. Brady (not Schwager), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 485, pl. 60, figs. 1, 2.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 341, pl. 12, figs. 20, 21.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 333, pl. 10, figs. 71, 72.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 54, fig. 5.

*Lagena lacunata* Burrows and Holland, in Jones, Palaeont. Soc., 1895, p. 205, pl. 7, fig. 12.

*Lagena orbignyana*, var. *castrensis* Millett, Journ. Roy. Micr. Soc., 1901, p. 626, pl. 14, fig. 20.

*Lagena orbignyana*, var. *lacunata* Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 19, pl. 2, fig. 14; Journ. Quekett Micr. Club, vol. 11, 1912, p. 416, pl. 19, figs. 16–18.

*Description.*—Variety with the body portion of the test marked by a network of lacunæ or pitted areas of varying size, usually darker in color than the rest of the test.

Length 0.35 mm.

*Distribution.*—Brady records this variety from the *Challenger* station south of Japan on the *Hyalonema*-ground, depth 345 fathoms. I have had material from three *Nero* stations between Guam and Yokohama, 1154 in 1,602 fathoms, 1300 in 1,529 fathoms, and 1310 in 518 fathoms. It also occurred at two *Albatross* stations off Japan, D4875 in 59 fathoms and D4966 in 290 fathoms, and at *Tuscarora* station 23, lat. 21° 40′ N.; long. 179° 20′ E., in 1,964 fathoms.

Schwager's figure and description call for a specimen with its ornamentation made up of raised beads on the body portion of the test. It seems that a distinction should be made between the raised beads and pitlike lacunæ.

### LAGENA ORBIGNYANA (Seguenza), var. CORONATA Sidebottom.

Plate 20, fig. 3.

*Lagena orbignyana* (Seguenza), var. *coronata* Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 416, pl. 19, fig. 15.

*Description.*—Variety with the central area translucent, surrounded by an opaque band, outside of which is the inner keel, peripherally bordered by the wider median keel, which is denticulate about the basal half of the border.

Length of North Pacific specimens 1 mm.

*Distribution.*—Found in the North Pacific material only at *Albatross* station H2902 in 1,783 fathoms near the Hawaiian Islands.

This seems to agree nearly enough with the above variety to warrant its being placed here. The opaque ring is here decidedly raised and annular but the other characters are very similar.

### LAGENA ORBIGNYANA (Seguenza), var. CONCENTRICA Sidebottom.

Plate 19, fig. 2.

*Lagena orbignyana* (SEGUENZA), var. *concentrica* SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 417, pl. 19, fig. 23.

*Description.*—Test compressed, but umbonate, median keel well developed, inner keel less prominent; body portion ornamented by concentric costæ, apertural end bluntly pointed.

Length 0.6 mm.

*Distribution.*—Figured specimen from *Nero* station 1464 in 891 fathoms off Guam.

Although more umbonate than shown in the figure referred to above, this specimen has all the essential characters of this variety.

### LAGENA ORBIGNYANA (Seguenza), var. CLATHRATA H. B. Brady.

Plate 11, fig. 4.

*Lagena clathrata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 484, between the two keels regularly crenulated, apertural end with a short broad neck, truncate.

Length 0.35 mm.

*Distribution.*—Type-specimen, Cat. No. 8542, U.S.N.M., from *Albatross* station H4878 in 84 fathoms off Japan. It also occurred at *Albatross* station D4957 in 437 fathoms; also off Japan and *Nero* station 1464 in 891 fathoms off Guam.

This variety seems rather distinctive.

### LAGENA ORBIGNYANA (Seguenza), var. ALATA, new variety.

Plate 23, fig. 1.

*Description.*—Variety with the central portion smooth, except at the border, where it is regularly pitted, peripheral keel extended outward into a very broad, thin keel extending about the entire test from the aperture, radiately striate, basal border tending to become denticulate.

Length 0.45 mm.

*Distribution.*—Type-specimen, Cat. No. 8543, U.S.N.M., from *Albatross* station D4953 in 1,350 fathoms off Japan.

This seems to be different from any of the previously described varieties of this species.

### LAGENA FAVOSO-PUNCTATA H. B. Brady.

Plate 11, fig. 5.

*Lagena favoso-punctata* H. B. Brady, Quart. Journ. Micr. Soc., vol. 21, 1881, p. 62; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 473, pl. 58, fig. 35; pl. 59, fig. 4; pl. 61, fig. 2.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 325, pl. 10, fig. 98.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 140.

*Description.*—Test ecto- or entosolenian, shape variable; surface areolated or reticulated, with a conspicuous orifice or perforation in the middle of each area or depression.

Length 0.34 mm. or less.

*Distribution.*—The only North Pacific records for this species are those given by Bagg, H4590 in 978 fathoms and H4694 in 865 fathoms off the Hawaiian Islands.

### LAGENA TRIGONO-MARGINATA Parker and Jones

Plate 14, figs. 3, 4.

*Lagena trigono-marginata* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 348, pl. 18, figs. 1*a*, *b*.—Wright, Proc. Belfast Nat. Field Club, 1876–77, App., p. 104, pl. 4, figs. 8*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 482, pl. 61, figs. 12, 13.

*Description.*—Test ovate or pyriform, trifacial, the angles of the test ornamented by a marginal beading with an acute edge often subcarinate, or smooth and without the beading, occasionally rounded and not distinctly carinate, aperture rounded.

Length 0.35 mm.

*Distribution.*—Brady records this species from one North Pacific *Challenger* station, 241 in 2,300 fathoms.

This has by some authors been referred to *L. orbignyana* as a variety.

### Subfamily 2. NODOSARIINÆ.

Test polythalamous; chambers arranged in a straight, arcuate, planospiral or uncoiling series, apertures either radiate or with a neck and phialine lip.

### Genus NODOSARIA Lamarck, 1812.

*Nodosaria* LAMARCK (type, *N. raphanistrum* (Linnæus), (Extrait Cours Zool., 1812, p. 121; Hist. Anim. Sans Vert., vol. 7, 1822, p. 596.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 488.

*Description.*—Test composed of a straight or arcuate series of chambers, either loosely joined together by stolons or close-set and overlapping or various forms between; surface smooth or ornamented; aperture either radiate or with a definite neck and phialine lip.

In this genus both microspheric and megalospheric forms occur. In some species the megalospheric proloculum is the largest chamber of the series and none of the following chambers attain so large a diameter. In the microspheric form the proloculum is very small and the chambers gradually increase in size.

shows that the two are synonymous. At present Montfort's poorly executed figures make it impossible to determine his species with certainty without such an examination of types, and at present this is impossible.

### NODOSARIA (GLANDULINA) ROTUNDATA (Reuss).

Plate 28, fig. 6.

*Glandulina rotundata* Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 366, pl. 46, fig. 2.

*Nodosaria* (*Glandulina*) *rotundata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 491, pl. 61, figs. 17–19.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 54, fig. 6.—Millett, Journ. Roy. Micr. Soc., 1902, p. 510.

*Description.*—Test oval or subovate, broadest in the middle, composed of few chambers, apical end broadly rounded, without spines, apertural end more elongate, aperture with radiate lines about the margin; last-formed chamber occupying one-half or more of the visible test.

Length 1 to 2 mm.

*Distribution.*—This species has not previously been recorded from the North Pacific. I have found it at *Albatross* station D4807, off Japan, in 44 fathoms.

Millett raises the question as to whether this and *N. laevigata* are microspheric and megalospheric forms of a single species.

In the figured specimen the last-formed chamber occupies rather more than usual of the surface of the test.

### NODOSARIA (GLANDULINA) LAEVIGATA d'Orbigny.

Plate 24, figs. 1, 2.

"Cornu Hammonis erectum globosius" Plancus, Conch. Min., 1739, p. 16, pl. 13, fig. 1.

*Nodosaria* (*Glandulina*) *laevigata* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 252, pl. 10, figs. 1–3.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 340, pl. 13, fig. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 490, pl. 61, figs. 20–22.—Burrows, Sherborn, and Bailey, Journ. Micr. Soc., 1890, p. 556, pl. 19, figs. 14, 15.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 71, pl. 13, figs. 702, 703, 705, 707, 709; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 59.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 55, fig. 3.—Millett, Journ. Roy. Micr. Soc., p. 509, pl. 11, fig. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 143.

*Glandulina laevigata* d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 29, pl. 1, figs. 4, 5.—Bornemann, Zeitschr. deutsch. Geol. Gess., vol. 7, 1855, p. 320, pl. 12, fig. 8.—Neugeboren, Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 67, pl. 1, figs. 3, 4.—Haeusler, Neues Jahrb. für Min., 1887, p. 189, pl. 5, fig. 29.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 336, 339, pl. 11, fig. 31.—Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 17, 1900, p. 248, pl. 6, figs. 41, 49.

*Description.*—Test fusiform, very broad in the middle, tapering rapidly toward either end; apical end usually with one or more spines;

chambers few, embracing, the last-formed one making up two-thirds or more of the visible test, sutures flush but marked by a distinct fine line; apical end somewhat rounded, usually with radiate lines about the aperture; wall smooth.

Length 2 mm. or more.

*Distribution.*—Brady records this species from the North Pacific in 7–95 fathoms. The latter depth represents the *Challenger* station off the Philippines. Goës records it at four *Albatross* stations in the eastern Pacific, D3371 in 770 fathoms, D3375 in 1,201 fathoms, D3376 in 1,132 fathoms, and D3407 in 885 fathoms. Bagg records it from three stations off the Hawaiian Islands, *Albatross* D4025 in 275–368 fathoms, H4555 in 1,398 fathoms, and H4696 in 367 fathoms. I have had material from the western portion of the region, *Albatross* D4843, off the coast of Korea in 100 fathoms, bottom temperature 39.9° F.

### NODOSARIA CALOMORPHA Reuss.

Plate 25, fig. 6.

*Nodosaria calomorpha* Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 129, pl. 1, figs. 15–19.—Terrigi, Atti Accad. Pont., ann. 33, 1880, p. 178, pl. 1, fig. 7.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 497, pl. 61, figs. 23–27.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, figs. 1, 4?—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 566, pl. 9, fig. 21.—Terrigi, Mem. Com. Geol. Italia, vol. 4, 1891, p. 78, pl. 2, fig. 5.—Chaster, First Rep. Southport Soc. Nat. Sci., 1890–1891 (1892), p. 63, pl. 1, fig. 12.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ɪɪ, vol. 18, 1893, p. 340, pl. 11, figs. 21, 26.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 72, pl. 13, figs. 712, 713.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 118, pl. 1, fig. 6.—

### NODOSARIA SIMPLEX Silvestri.

Plate 28, fig. 5.

*Nodosaria simplex* SILVESTRI, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 95, pl. 11, figs. 268–272.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 496, pl. 62, figs. 4, 5, and 6?—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 340, pl. 11, fig. 6.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 309, pl. 55, fig. 2.

*Description*.—Test composed of two or more chambers, the initial chamber globular with a short spine at the base, the second pyriform with a well drawn out neck and radiate aperture; wall smooth, sutures well depressed.

Length about 1 mm.

*Distribution*.—There are no previously published records for this species in the North Pacific. The only record I have is *Albatross* D2806 off the Galapagos Islands in 1,379 fathoms. The specimen obtained here is very typical, like Silvestri's figures and like fig. 4 of the *Challenger* report.

### NODOSARIA PYRULA d'Orbigny.

Plate 26, figs. 1–3.

"Orthoceras Monile" SOLDANI, Testaceographia, vol. 2, 1798, p. 35, pl. 10, figs. *b*, *c*.

*Nodosaria pyrula* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 253, No. 13.—WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 17, pl. 2, fig. 39.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 497, pl. 62, figs, 10–12.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28, 1885, p. 343, pl. 12, fig. 23.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, fig. 2.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 345, pl. 11, figs. 14, 15.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 309, pl. 55, fig. 4.—MILLETT, Journ. Roy. Micr. Soc., 1902, p. 514.

*Description*.—Test elongate, very slender, composed of numerous chambers, either in a straight or slightly curved line, pyriform in shape with long tapering necks; surface smooth, chambers varying little in size; proloculum extended backward in a long drawn out point.

Length up to 8 mm.

*Distribution*.—Brady records this species at two *Challenger* stations, 95 fathoms off the Philippines and the *Hyalonema*-grounds off Japan, 345 fathoms. Goës had specimens which he records under *N. monile* from two *Albatross* stations, D3375 in 1,201 fathoms and D3431 in 995 fathoms, in the eastern Pacific. I have seen only broken specimens in the material examined from *Albatross* station D4891, off Japan, 181 fathoms, bottom temperature 50.2° F., and D4807, off Japan, in 44 fathoms.

Specimens are rarely obtained in an entire condition due to the delicacy of the connecting stolonlike necks. It is a species of comparatively shallow and comparatively warm water from the records available.

### NODOSARIA PYRULA d'Orbigny, var. SEMIRUGOSA d'Orbigny.

Plate 26, figs. 4-8.

*Nodosaria semirugosa* D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 34, pl. 1, figs. 20-23.—MILLETT, Journ. Roy. Micr. Soc., 1902, p. 515, pl. 11, fig. 5.

*Nodosaria* No. 35, VON SCHLICHT, Foram. Septarien Thones von Pietzpuhl, 1870, p. 24, pl. 7, fig. 20.

*Nodosaria stipitata* REUSS, var. *costulata* REUSS, Sitz. Akad. Wiss. Wien, vol. 62, Abth. 1, 1870, p. 471.

*Nodosaria costulata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 515, pl. 63, figs. 23-27.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 58, fig. 1.

*Description.*—Similar to typical *Nodosaria pyrula*, but with the basal portion of each chamber with several costæ and alternating depressions.

*Distribution.*—Brady records this species at the *Challenger* station off the Philippines in 95 fathoms. I have it from *Albatross* D4807 in 44 fathoms off Japan. From material examined it seems that this is but a variable form of *N. pyrula* and frequently occurs with it in tropical and subtropical waters. Millett is certainly right in referring this form to *N. semirugosa* d'Orbigny.

### NODOSARIA GUTTIFERA (d'Orbigny).

### NODOSARIA PAUPERATA (d'Orbigny).

Plate 25, fig. 7.

*Dentalina pauperata* D'ORBIGNY, For. Foss. Bass. Tert. Vienne, 1846, p. 46, pl. 1, figs. 57, 58.—BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 324, pl. 13, fig. 7.—H. B. BRADY, Proc. Somerset Arch. and Nat. Hist. Soc., vol. 13, 1867, p. 108, pl. 1, fig. 14.

*Nodosaria pauperata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 500, woodcuts figs. 14*a*, *b*, *c*.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 68, pl. 12, figs. 682–688 [part]; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 61.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.

*Description.*—Test comparatively short, slightly arched, tapering, composed of a few chambers, cylindrical in the early portion, later chambers more inflated; apical end usually with a short spine; apertural end slightly prolonged.

Length 2 mm.

*Distribution.*—Goës records rather poor examples of this species from three *Albatross* stations in the eastern Pacific, D3363 in 978 fathoms, D3376 in 1,132 fathoms, and D3399 in 1,740 fathoms. Bagg records it from the vicinity of the Hawaiian Islands at two *Albatross* stations, D4000 in 104–213 fathoms and D4025 in 275–368 fathoms. These specimens also are not typical, one broken one being here figured. It is not mucronate and the apertural portion is broken away.

### NODOSARIA ABYSSORUM H. B. Brady.

Plate 28, fig. 7.

*Nodosaria* (?) *abyssorum* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 63; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 504, pl. 63, figs. 8, 9.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 342, pl. 11, fig. 11 [?].

*Description.*—Test elongate, composed of several chambers, straight or slightly arcuate, chambers inflated, subspherical, sutures much depressed, surface smooth, apical end broadly rounded, with a group of short acicular spines; aperture at the end of a short neck, with a phialine lip.

Length up to 4 mm.

*Distribution.*—This species has not previously been recorded in the North Pacific. I have it from two stations, *Nero* 1302 in 1,331 fathoms and 1867 in 2,311 fathoms in the western Pacific. The figured specimen from the first station is evidently broken, showing but the two early chambers. The specimen from the second station is also broken, but composed of eight chambers, and except for the larger number of chambers and broken lip is very similar to Brady's figures in the *Challenger* report.

This seems to be a rare, deep-water species.

### NODOSARIA PROXIMA Silvestri.

*Nodosaria proxima* Silvestri, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 63, pl. 6, figs. 138–147.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 511, pl. 64, fig. 15.—Fornasini, Mem. Accad. Sci. Bologna, ser. 5, vol. 4, 1894, p. 206, pl. 1, figs. 33–35.—Millet, Journ. Roy. Micr. Sci., 1902, p. 519, pl. 11, fig. 9.

*Description.*—Test composed of few chambers, usually two, with several costæ, apical end often spinose; aperture at the end of a tubular neck.

Length 1 mm.

*Distribution.*—Brady records this species from two North Pacific stations, off the Philippines in 95 fathoms and from the coral reefs of Honolulu, Sandwich Islands, in 40 fathoms. I have seen no material which can not be referred to other species as young specimens.

### NODOSARIA RADICULA (Linnæus).

"Cornu Hammonis erectum" Plancus, Conch. Min., 1739, p. 14, pl. 1, fig. 5.

*Nautilus radicula* Linnæus, Syst. Nat., ed. 12, 1767, p. 1164, 285; (Gmelin's) ed. 13, 1788, vol. 1, pt. 6, p. 3373, No. 18.—Montagu, Test. Brit., 1803, p. 197, pl. 6, fig. 4.

*Nodosaria radicula* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 252, No. 3; Modèles, No. 1.—H. B. Brady, Proc. Somerset Arch. and Nat. Hist. Soc., vol. 13, 1867, p. 106, pl. 1, fig. 4; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 495, pl. 61, figs. 28–31.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 746, pl. 14, fig. 24.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 60.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 309, pl. 55, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1902, p. 513.

*Description.*—Test elongate, composed of three or four chambers, with but slightly depressed sutures, wall smooth, apical end with a

*Distribution.*—Brady records this species at the *Challenger* station off the Philippines in 95 fathoms. I have had material from three stations, *Tuscarora* 2, lat. 21° 07′ N., long. 158° 14′ W., in 1,468 fathoms, and *Albatross* D4843 in 100 fathoms and D4979 in 943 fathoms. The bottom temperatures at these two stations were 39.9° and 36.4° F., respectively.

In some ways this species is intermediate between *N. pyrula* and *N. soluta*, and may be only a variety of the former. The peculiar dark appearance of the clear portions is rather distinctive.

### NODOSARIA SOLUTA (Reuss).

Plate 26, figs. 9–11.

*Dentalina soluta* REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 60, pl. 3, figs. 4*a*, *b*.—STACHE, *Novara* Exped., Geol. Theil, vol. 1, 1864, p. 203, pl. 22, fig. 29.—HANTKEN, Mitth. Jahrb. Ung. Geol. Anstalt., vol. 4, 1875, p. 29, pl. 2, figs. 2, 14.

*Nodosaria soluta* BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 322, pl. 12, fig. 12.—REUSS, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 131, pl. 2, figs. 4–8.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 503, pl. 62, figs. 13–16; pl. 64, fig. 28.—SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1886, p. 746, pl. 14, figs. 25, 26.—BURROWS, SHERBORN, and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 557, pl. 9, fig. 26.—CHAPMAN, Journ. Roy. Micr. Soc., 1893, p. 587, pl. 8, fig. 26.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 70, pl. 12, fig. 690; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 62.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 3.—MILLETT, Journ. Roy. Micr. Soc., 1902, p. 516.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.

*Description.*—Test elongate, somewhat arcuate, comparatively stout, composed of rather few globular or ovate chambers, inflated, sutures much depressed, aperture radiate with an acute neck, apical end often with a short spine; wall of the distal portion of the chamber smooth, the proximal half of each chamber usually roughened, often conspicuously so, sometimes faintly striate; color chalky white, opaque.

Length up to 6 mm. or more.

*Distribution.*—Goës recorded this species from the eastern Pacific at three *Albatross* stations, D3375, in 1,201 fathoms; D3376, in 1,132 fathoms; and D3407, in 885 fathoms. Flint records it from *Albatross* station, D2805, in 51 fathoms, Panama Bay, and Bagg from one *Albatross* station, H4964, in 865 fathoms, off the Hawaiian Islands. The only stations from which I have had material are, *Nero* 1298, in 1,711 fathoms, off Japan, and *Albatross* D4957, in 437 fathoms, also off Japan.

### NODOSARIA HAUERIANA Neugeboren.

Plate 25, fig. 4.

*Nodosaria haueriana* NEUGEBOREN, Verh. Mitth. sieb. Ver. Nat., vol. 3, 1852, p. 39, pl. 1, figs. 8, 9.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 341, pl. 11, figs. 1, 25.

*Description.*—Test elongate, tapering, composed of few chambers, elongate pyriform, sutures much depressed, wall smooth, apertural end of last formed chamber very tapering.

Length about 1.50 mm.

*Distribution.*—Egger records this species off West Australia. The specimen here figured is from *Albatross* station D4966, off Japan, in 290 fathoms, bottom temperature 44.1° F.

### NODOSARIA COMMUNIS d'Orbigny.

Plate 28, figs. 1, 2.

*Nodosaria* (*Dentalina*) *communis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 35.

*Dentalina communis* D'ORBIGNY, Mém. Soc. Géol. France, vol. 4, 1840, p. 13, pl. 1, fig. 4.

*Nodosaria communis* REUSS, Verst. Böhm. Kreid., pt. 1, 1845, p. 28, pl. 12, fig. 21.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 504, pl. 62, figs. 19–22.—BURROWS, SHERBORN, and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 557, pl. 9, fig. 27.—CHAPMAN, Journ. Roy. Micr. Soc., 1893, p. 590, pl. 9, fig. 1.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 342, pl. 11, figs. 22–24.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 67, pl. 12, figs. 667–671; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 61, pl. 6, fig. 1.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 2.—MILLETT, Journ. Roy. Micr. Soc., 1902, p. 522.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 142.

### NODOSARIA FILIFORMIS d'Orbigny.

Plate 27, figs. 1–4.

"Orthoceratia filiformia aut capillaria" Soldani, Testaceographia, vol. 2, 1798, p. 35, pl. 10, fig. *e*.

*Nodosaria filiformis* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 253, No. 14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 500, pl. 63, figs. 3–5.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 55, fig. 6.—Millett, Journ. Roy. Micr. Soc., 1902, p. 523.

*Dentalina filiformis* Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 156, pl. 9, fig. 48.

*Description.*—Test elongate, slender, arcuate, chambers numerous, elliptical or ovate, elongate, tumid, sutures usually oblique, chambers increasing in length toward the apertural end, aperture radiate, slightly eccentric; wall smooth.

Length up to 5 mm.

*Distribution.*—Brady in the *Challenger* report mentions this species as being found in the North Pacific, but stations are not given. I have had material from the following stations: *Albatross* D3608 in 276 fathoms; material from stomachs of holothurians, D4900, in 139 fathoms off Japan; *Nero* station 1466, near Guam, in 234 fathoms; and *Tuscarora* station 11, in 437 fathoms, lat. 33° 46′ N.; long. 140° 21′ E.

Specimens are easily broken and complete specimens seem to be rare.

### NODOSARIA ROEMERI (Neugeberen).

Plate 24, figs. 4–6.

*Dentalina roemeri* Neugeboren, Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 82, pl. 2, figs. 13–17.

*Nodosaria roemeri* Reuss, Sitz. Akad. Wiss. Wien, vol, 62, 1870, p. 475.—von Schlicht, Foram. Septarien Thones von Pietzpuhl, 1870, pl. 10, figs. 21, 22, 24.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 505, pl. 63, fig. 1.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 5.

*Description.*—Test elongate, somewhat arcuate, comparatively stout, composed of few chambers, early ones with little inflation, later ones somewhat inflated, apical end rounded, sutures oblique, wall smooth.

Length up to 4.5 mm.

*Distribution.*—Bagg records this species from one *Albatross* station off the Hawaiian Islands, H4566, in 572 fathoms. I have had material from three *Nero* stations, 10, near the Hawaiian Islands, in 2,098 fathoms; 201, near Midway Islands, in 1,033 fathoms; and 990, near Guam, in 859 fathoms.

The species is not well distinguished from *N. communis* and seems to be intermediate between this and *N. mucronata*.

### NODOSARIA CONSOBRINA (d'Orbigny), var. EMACIATA (Reuss).

Plate 27, fig. 9.

*Dentalina emaciata* REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 63, pl. 3, fig. 9.

*Nodosaria* (*D.*) *consobrina*, var. *emaciata* REUSS, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 132, pl. 2, figs. 12, 13.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 502, pl. 62, figs. 25, 26.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 1.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 143.

*Description.*—Test elongate, tapering, slightly curved, composed of numerous chambers, short and cylindrical in form, sutures but slightly depressed in the early portion, later chambers more tumid and sutures somewhat depressed; wall smooth, apical and rounded. Length up to 8 mm.

*Distribution.*—Bagg records this form from *Albatross* station D4000 in 104–213 fathoms off the Hawaiian Islands. I have had material from the same region at *Albatross* station H2922 in 268 fathoms, bottom temperature, 44.8° F.; H2986 in 271 fathoms; and *Nero* station 2071 in 271 fathoms. It occurred at *Nero* station 1464 in 891 fathoms, off Guam; and *Albatross* stations H4882 in 248 fathoms, off southern Japan, bottom temperature, 48.8° F., and D4965, also off Japan, in 191 fathoms, bottom temperature, 49.4° F.

### NODOSARIA MUCRONATA (Neugeboren).

Plate 24, fig. 3; plate 25, fig. 2; plate 27, figs. 5–7; plate 35, fig. 6.

"Orthoceras intortum" SOLDANI, Testaceographia, vol. 1, pt. 2, 1791, p. 98, pl.

1145, 1293, 1299, and 1302, between Guam and Japan, with depths, respectively, 2,119, 2,141, 1,817 and 1,331 fathoms.

At *Nero* station 1145 a specimen was found, plate 35, figures 6*a*, *b*, which may be compared to some of the abnormal specimens, figured by Brady and others. Such forms seem to occur rather frequently in this species.

### NODOSARIA JAPONICA, new species.

Plate 28, fig. 4.

*Description.*—Test much elongate, large, tapering, composed of numerous cylindrical chambers, sutures of clear material, walls of chambers whitish; apical end often slightly bulbous at the beginning then somewhat contracting before again enlarging as chambers are added; walls smooth, sutures indistinct in outline, but very distinct on account of the difference in texture of the material forming them; last formed chamber in adult specimens often more rounded and distinct, aperture with a tapering neck which is fluted about the opening.

Length up to 16 mm.

*Distribution.*—This species has occurred off Japan at *Albatross* station D4900 in 139 fathoms, bottom temperature 52.9° F. This seems to be a well-distinguished species.

*Type-specimen.*—Cat. No. 8544, U.S.N.M.

### NODOSARIA CATENULATA H. B. Brady.

Plate 25, fig. 3.

*Nodosaria catenulata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 515, pl. 63, figs. 32–34.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 58, fig. 2.

*Description.*—Test elongate, slender, straight or more often slightly arcuate, tapering; apical end bearing a well-developed spine; chambers numerous, elliptical or ovate, distinctly separated by deep sutures; walls smooth, ornamented by four or six equidistant longitudinal costæ bridging the depressions between the chambers but usually not continuous over the chambers; costæ more or less rounded; aperture small at the end of a long tapering neck, the apertural end of which is costate giving a stellate appearance in end view.

Length up to 2 mm.

*Distribution.*—Brady described this species from off the Philippine Islands in 95 fathoms. The only other North Pacific record I have for this species is *Albatross* station H2922 in 268 fathoms off the Hawaiian Islands. Brady records it also from Torres Strait and it is apparently a warm-water species.

The figured specimen is a young one consisting of but three chambers. The view by transmitted light shows the relation of the chambers and the wall.

### NODOSARIA LONGIROSTRATA, new species.

Plate 27, fig. 8.

*Description.*—Test elongate, composed of few very elongate chambers, sutures slightly depressed, wall smooth, aperture at the end of a long tubular neck, somewhat clavate at the tip with several flange-like extensions, bicarinate.

Length of broken specimen 2.50 mm.

*Distribution.*—Type-specimen, Cat. No. 8545, U.S.N.M., from *Albatross* station D4949 in 110 fathoms, off Japan, bottom temperature 57.8° F.

This is a very elongate species, the chambers being several times as long as wide and the peculiar form of the apertural end makes it especially distinctive.

### NODOSARIA SCALARIS (Batsch).

Plate 24, fig. 7.

"Orthoceratia Flosculi" SOLDANI, Testaceographia, vol. 1, pt. 2, 1791, p. 91, pl. 95, figs. B–M.

*Nautilus* (*Orthoceras*) *scalaris* BATSCH, Conch. des Seesandes, 1791, No. 4, pl. 2, figs. 4*a*, *b*.

*Nodosaria scalaris* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 340, pl. 16, figs. 2*a*, *b*, *c*.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 157, pl. 9, fig. 42.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 510, pl. 63, figs. 28–31.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, figs. 6, 19.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 73, pl. 13, figs. 716–718.

*Nodosaria longicauda* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 28.

### NODOSARIA RAPHANUS (Linnæus).

Plate 26, figs. 12, 13.

"Cornu Hammonis erectum striatum" PLANCUS, Conch. Min., 1739, p. 15, pl. 1, fig. 6.

"Orthoceras minimum" etc. GAULTIERI, Index Test., 1742, pl. 19, fig. L.

*Nautilus raphanus* LINNÆUS, Syst. Nat., ed. 12, 1767, p. 1164, (Gmelin's), ed. 13, 1788, p. 3372, No. 16.

*Orthocera raphanus* LAMARCK, Anim. sans. Vert., vol. 7, 1822, p. 593, No. 1; Tabl. Encycl. et Méth., pl. 465, fig. 2*a*, *b*, *c*.

*Nodosaria raphanus* PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 3, 1859, p. 477.—SILVESTRI, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 43, pl. 4, figs. 67–81.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 512, pl. 64, figs. 6–10.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 64.

Goës in the paper last quoted above records this species from *Albatross* station D3353 in 695 fathoms, one small specimen. I have been unable to find a specimen so labeled in the Goës collection, and as there are no other records for the species in this region the record must remain a doubtful one.

### NODOSARIA OBLIQUA (Linnæus).

Plate 25, fig. 5.

"Orthoceras minimum" etc. GAULTIERI, Index Test., 1742, pl. 19, fig. N.

*Nautilus obliquus* LINNÆUS, Syst. Nat., ed. 12, 1767, p. 1163 (Gmelin's), ed. 13, 1788, p. 3372, No. 14.

*Nodosaria* (*Dentalina*) *obliqua* PARKER and JONES, Ann. Mag. Hist., ser. 3, vol. 3, 1859, p. 482.

*Nodosaria obliqua* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 513, pl. 64, figs. 20–22.—H. B. BRADY, PARKER, and JONES, Trans. Zoöl. Soc. London, vol. 12, 1888, p. 223, pl. 44, fig. 7.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 63.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 311, pl. 57, fig. 4.

*Description.*—Test long and tapering, composed of numerous chambers, slightly inflated toward the apical end, more inflated and distinctly separated toward the apertural end, apical end usually with a single large spine, surface of the test with numerous distinct costæ running longitudinally the length of the test, aperture with an elongate neck smooth or nearly so.

Length up to 8–10 mm. or even more.

*Distribution.*—Brady speaks of this species as found in "every sea and at almost every depth from the laminarian zone to 1,500 to 2,000 fathoms." Goës found specimens from two stations off the west coast of North America, *Albatross* D3376 in 1,132 fathoms and D3407 in 885 fathoms. I have seen a few broken specimens only in the region.

### NODOSARIA VERTEBRALIS (Batsch).

Plate 32, fig. 1.

*Nautilus* (*Orthoceras*) *vertebralis* BATSCH, Conch. des Seesandes, 1791, p. 3, No. 6, pl. 2, fig. 6*a*, *b*.

*Nodosaria vertebralis* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 514, pl. 63, fig. 35; pl. 64, figs. 11–14.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 312, pl. 57, fig. 5.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 57, fig. 5.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.

*Description.*—Elongate, slender, tapering, straight or very slightly arcuate, chambers comparatively short, numerous, little inflated, sutures of clear shell material, appearing darker than the opaque portions; surface ornamented with longitudinal costæ, apical end usually with a short spine.

Length up to 6 mm.

*Distribution.*—The only record from the North Pacific is that of Bagg, *Albatross* station D4000 in 104–213 fathoms off the Hawaiian Islands. From its distribution this seems to be a species of comparatively warm shallow water of tropical and subtropical seas.

### NODOSARIA HIRSUTA d'Orbigny.

Plate 28, fig. 3.

"Orthoceratia quasi hispida" SOLDANI, Testaceographia, vol. 2, 1798, p. 15, pl. 2, fig. P.

"Orthoceratia hispida" SOLDANI, Testaceographia, vol. 2, 1798, p. 36, pl. 11, figs. *n*–*z*, A, B.

*Nodosaria hirsuta* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 252, No. 7.

*Nodosaria hispida* D'ORBIGNY, For. Foss. Bass. Tert. Vienne, 1846, p. 35, pl. 1, figs. 24, 25.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser.

## Genus LINGULINA d'Orbigny, 1826.

*Lingulina* D'ORBIGNY (type *L. carinata* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 256.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 517.

*Description.*—Test compressed, chambers arranged in a linear series, usually closely set: aperture usually elongate, corresponding to the form of the chamber.

This genus seems to be less clearly defined than many of the genera established by d'Orbigny. It is closely related to *Nodosaria*, differing from this genus only in the compressed character and the consequent changes in the aperture.

Species of this genus are few in number but have a wide range. It is most common as a fossil in the Miocene.

### LINGULINA CARINATA d'Orbigny.

Plate 29, fig. 3.

*Lingulina carinata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 257, No. 1; Modèles No. 26.—BARKER, WEBB, and BERTHELOT, Hist. Nat. Iles Canaries, vol. 2, pt. 2, Foraminifères, 1839, p. 124, pl. 1, figs. 5, 6.—WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 14, pl. 2, figs. 33–35.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 517, pl. 65, figs. 16, 17.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28, 1888, p. 343.—SHERBORN and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 558, pl. 10, fig. 3.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 484.—EGGER, Abh. kön. bay. Acad. Wiss. München, Cl. II, vol. 18, 1893, p. 345, pl. 11, fig. 8, 20.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 58, fig. 3.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.
*Nodosaria carinata* GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 74, pl. 13, figs. 714–715 [?].

*Description.*—Test compressed, chambers in a linear series, early ones short and broad, later ones usually hyaline, edges nearly acute, surface smooth; aperture an elongated, simple ellipse without a definite neck or radiate openings.

Length up to 3 mm.

*Distribution.*—In the North Pacific, Brady records this species from the *Challenger* dredgings, off the Honolulu coral reefs, Hawaiian Islands, in 40 fathoms. Bagg records it as rare off the same islands, *Albatross* station 4508, in 495 fathoms. This is the specimen figured here.

Many forms have been figured as belonging to this species which it does not seem should be placed here, as their characters are so unlike the type of d'Orbigny's species.

Nodosarian, but the chambers usually keep an oblique tendency and the sutures usually oblique, at least in side view. Some species are very much compressed, while others are tumid or strongly umbonate. The surface of the test may be smooth or it may be variously ornamented with costæ, limbate sutures, knobs and bosses, spines or combinations of them and often the peripheral border is broadly keeled. Altogether except for *Lagena* it presents a greater range of ornamentation than any genus of the Lagenidæ. The aperture is usually very characteristic, being distinctly radiate and in some species being visible in many of the earlier chambers even when adult size is reached.

The genus is widely distributed geographically and bathymetrically, although it undoubtedly reaches its greatest development in comparatively shallow water—less than 500 fathoms—in rather warm waters, as about tropical islands. It is, however, found in great numbers in colder waters, but the species are fewer in number and lack the extravagant ornamentation seen in the tropical species. Geologically the range of the genus is a long one, its earliest limits not being satisfactorily determined.

There are several names of Montfort which were used previously to the use of *Cristellaria* by Lamarck, but these are ill defined and the poorly executed figures makes it impossible without a study of the types to say just what species the author had in mind. With such an ill-defined condition it seems ill advised at the present time to replace *Cristellaria* with any of Montfort's names. With a study of the types it may be necessary to do this.

### CRISTELLARIA CULTRATA (Montfort).

Plate 29, fig. 4.

"Cornu Hammonis" PLANCUS, Conch. Min., 1760, p. 120, pl. 1, fig. 12.

"Nautili (*Lenticulae marginatae*)" SOLDANI, Testaceographia, vol. 1, pt. 1, 1789, p. 54, pl. 33, fig. B.

*Robulus cultratus* MONTFORT, [?] Conch. Syst., vol. 1, 1808, p. 214, 54e genre.

*Robulina cultrata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 287, No. 1; Modèles, No. 82; Foram. Foss. Bass. Tert. Vienne, 1846, p. 96, pl. 4, figs. 14, 15.

*Cristellaria cultrata* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 344, pls. 13, 17, 18; pl. 16, fig. 5.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 550, pl. 70, figs. 4, 5, 6.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 352, pl. 12, figs. 8–10, 24, 25.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 318, pl. 65, fig. 2.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 147.

*Description.*—Test very similar to that of *C. rotulata*, but with the added character of a peripheral keel of greater or less extent.

Length up to 4 mm.

*Distribution.*—Brady records this species from a single North Pacific station, off the Philippines in 95 fathoms. Bagg records it from three *Albatross* stations, off the Hawaiian Islands; D4000 in 104–213 fathoms; H4566 in 572 fathoms; and H4696 in 367 fathoms.

Fine large specimens occur off the Pacific coast of the United States and in Bering Sea in comparatively shallow cold water. Occasional specimens occur off Japan being common at one station, *Albatross* D5056 in 258 fathoms, bottom temperature 46° F. It also occurred off the Hawaiian Islands, *Albatross* H3007 in 323 fathoms.

The main distinguishing character between this species and *C. rotulata* is the presence of the broad keel in *C. cultrata*. The distribution, at least so far as is shown by the North Pacific material examined, is by no means coextensive in the two species.

### CRISTELLARIA RENIFORMIS d'Orbigny.

Plate 30, fig. 4; plate 33, fig. 1.

*Cristellaria reniformis* D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 88, pl. 3, figs. 39, 40.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 539, pl. 70, figs. 3*a*, *b*.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 315, pl. 62, fig. 2.—BAGG, Bull. 513, U. S. Geol. Survey, 1912, p. 66, pl. 19, figs. 2*a*, *b*.

*Description.*—Test compressed, somewhat elongated, early chambers forming a close coiled test, later chambers becoming longer and a tendency toward an elongate form is shown, with oblique sutures; wall smooth; peripheral border slightly to strongly keeled; aperture often slightly produced, radiate.

Length up to 5 mm.

*Distribution.*—Brady records this species from the North Pacific in 2,050 fathoms in the *Challenger* report, but in the volume on the Summary of Results it is also recorded from *Challenger* station 237 in 1,875 fathoms. I have had material which seems to belong to this species from three *Albatross* stations, D4310, D4972 in 440 fathoms, bottom temperature 39.8° F., and D5078 in 514 fathoms, bottom temperature 38.9° F., off Japan. It also occurred at *Nero* station 1302 in 1,331 fathoms, also off Japan.

### CRISTELLARIA ARTICULATA Reuss.

Plate 31, fig. 1.

*Robulina articulata* REUSS, Sitz. Akad. Wiss. Wien, vol. 48, 1863, p. 53, pl. 5, fig. 62.

*Cristellaria articulata* REUSS, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 483.—VON SCHLICHT, Foram. Pietzpuhl, 1870, pl. 17, figs. 5–12.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 547, pl. 69, figs. 10–12.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 64, fig. 2.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 146.

*Description.*—Test close coiled, nearly circular in side view, thick, chambers tumid, sutures depressed; periphery obtusely angled; aperture exserted, broad and rounded in side view, radiate; umbonal portion of test often of clear shell material.

Length up to 3 mm.

*Distribution.*—Bagg records this species from a single *Albatross* station H4696 in 376 fathoms off the Hawaiian Islands. I have had material from four stations, all off Japan; H4882 in 248 fathoms, bottom temperature 48.8° F.; D4893 in 106 fathoms, bottom temperature 55.9° F.; D4895 in 95 fathoms; and D4964 in 37 fathoms, bottom temperature 66.6° F.

### CRISTELLARIA ROTULATA (Lamarck).

Plate 35, fig. 3.

"Cornu Hammonis seu Nautili" Plancus, Conch. Min., 1739, p. 13, pl. 1, fig. III.

*Lenticulites rotulata* Lamarck, Ann. Mus., vol. 5, 1804, p. 188, No. 3; vol. 8, 1806, pl. 62, fig. 11.

*Cristellaria rotulata* d'Orbigny, Mém. Soc. Géol. France, ser. 1, vol. 4, 1840, p. 26, pl. 2, figs. 16–18.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 345, pl. 13, fig. 19.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 547, pl. 69, figs. 13*a*, *b*.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 224, pl. 64, fig. 15.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 351, pl. 12, figs. 1, 2, 32, 33.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 3, 1893, p. 435, pl. 2, fig. 11; vol. 4, 1894, p. 221, pl. 3, figs. 24, 25.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 60, pl. 10, figs. 559–578; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 54.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 64, fig. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 148; Bull. 513, U. S. Geol. Surv., 1912, p. 67, pl. 19, figs. 5*a*, *b*.

*Description.*—Test large, close coiled, chambers numerous, lenticu-

### CRISTELLARIA NITIDA d'Orbigny.

Plate [illegible], fig. [illegible]

"Nautili Lituitati" SOLDANI. Testaceographia [illegible] figs. O, P.

*Cristellaria nitida* D'ORBIGNY. Ann. Sci. Nat. [illegible] —H. B. BRADY. Rep. Voy. *Challenger*, Zoology [illegible]

*Description*.—"A feeble modification [illegible] '*mamilligera*' group. The shell is compressed [illegible] earlier sutures limbate. It is a [illegible]

Length 1.4 mm.

*Distribution*.—The only record [illegible] in the North Pacific is that given by Brady [illegible] 95 fathoms off the Philippines.

The description and figure are taken from the [illegible]

### CRISTELLARIA ORBICULARIS d'Orbigny.

Plate [illegible], fig. [illegible]

"Nuclei conico rotundati" SOLDANI. Testaceographia [illegible] pl. 1, fig. 12, p. P.

*Robulina orbicularis* D'ORBIGNY. Ann. Sci. Nat. [illegible] figs. 8, 9.

*Cristellaria orbicularis* H. B. BRADY. Rep. Voy. *Challenger*, Zoology [illegible] p. 549, pl. 69, fig. 17.—FLINT. Rep. U. S. Nat. Mus. [illegible] 64, fig. 3.—[?] BAGG. Proc. U. S. Nat. Mus. [illegible]

*Description*.—Test very similar to *C.* [illegible] extended into a distinct keel, varying in width.

Length 1 to 1.5 mm.

*Distribution*.—Bagg records this species from *Albatross* station H4508 in 495 fathoms near the Hawaiian Islands [illegible] material from *Albatross* stations off Japan, D4[illegible] in 44 fathoms [illegible] in 71 fathoms, bottom temperature [illegible] bottom temperature 50.2° F.; and D4[illegible] bottom temperature 52.9° F. It also occurred [illegible] fathoms near the Midway Islands.

This species seems to be very [illegible] except in the character of the keel. [illegible] seem to me to be rather different [illegible] form figured by d'Orbigny. The [illegible] the chambers much shorter, and the [illegible]

### CRISTELLARIA VORTEX (Fichtel and Moll).

Plate 32, fig. 3.

"Nautili globuli" SOLDANI, Testaceographia, vol. 1, pt. 1, 1879, p. 66, pl. 59, fig. *tt*.

*Nautilus vortex* FICHTEL and MOLL, Test. Micr., 1803, p. 33, pl. 2, figs. *d–i*.

*Polystomella vortex* BLAINVILLE, Man. de Malac., 1825, p. 389.

*Robulina vortex* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 288, No. 4.

*Cristellaria vortex* PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 240, pl. 10, fig. 82.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 548, pl. 69, figs. 14–16.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 65, fig. 1.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 148.

*Description.*—Test close coiled, biconvex, umbonate; chambers elongate, curved, the sutures making a long curve from the periphery to the umbo; peripheral margin acute but not distinctly carinate; wall smooth.

Length 1 to 1.5 mm.

*Distribution.*—Bagg records this species from a single *Albatross* station H4508 in 495 fathoms off the Hawaiian Islands. I have had specimens from *Albatross* H3007 in 323 fathoms also off the Hawaiian Islands and *Nero* station 990 in 859 fathoms off Guam.

### CRISTELLARIA CONVERGENS Bornemann.

Plate 34, fig. 3.

*Cristellaria convergens* BORNEMANN, Zeitschr. deutsch. Geol. Ges., vol. 7, 1855, p. 327, pl. 13, figs. 16, 17.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 546, pl. 69, figs. 6, 7.

### CRISTELLARIA ACUTAURICULARIS (Fichtel and Moll).

Plate 35, fig. 2.

"Hammoniæ subrotundæ" SOLDANI, Testaceographia, vol. 1, pt. 1, 1789, p. 61, pl. 49, fig. X.

*Nautilus acutauricularis* FICHTEL and MOLL, Test. Micr., 1803, p. 102, pl. 18, figs. *g–i*.

*Cristellaria acutauricularis* PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 114.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 543, pl. 114, figs. 17*a*, *b*.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 353, pl. 12, figs. 19, 20.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 316, pl. 63, fig. 5.

*Description.*—Test thick, slightly elongate; early chambers close coiled, later ones elongate and oblique; sutures somewhat depressed; wall smooth, apertural end rather pointed.

Length less than 1 mm.

*Distribution.*—The only published record for this species in the North Pacific is that of Brady in the *Challenger* Report. It occurred off the Philippines in 95 fathoms. I have had material referable to this species only from *Nero* 2055 in 536 fathoms near the Hawaiian Islands.

This species is close to *C. crepidula*, from which it seems to differ only in the less compressed and less elongate form of the test.

### CRISTELLARIA GIBBA d'Orbigny.

Plate 35, fig. 1.

*Cristellaria gibba* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 63, pl. 7, figs. 20, 21.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 546, pl. 69, figs. 8, 9.—BURROWS, SHERBORN, and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 259, pl. 10, figs. 19, 21.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 352, pl. 12, figs. 21, 27.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 61, pl. 10, figs. 287, 288.—FORNASINI, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 4, 1894, p. 221, pl. 3, fig. 20.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 55.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 64, fig. 1.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 147.

*Description.*—Somewhat oval; biconvex; inner face decidedly contracted; peripheral margin somewhat keeled; wall smooth; sutures not depressed; apertures of earlier chambers usually apparent, even in adult condition.

Length usually 1 to 1.5 mm.

*Distribution.*—Goës records this species from a single *Albatross* station in the eastern Pacific, D3376 in 1,132 fathoms. Bagg records it from two stations off the Hawaiian Islands, *Albatross* D4000 in 104 to 213 fathoms and H4694 in 865 fathoms. I have had material from one *Nero* station, 2055 off the Hawaiian Islands in 536 fathoms and from three *Albatross* stations off Japan, D4958 in 405 fathoms, bottom temperature 40.1° F.; D5055 in 124 fathoms, bottom temperature 56.6° F.; and H4882 in 248 fathoms, bottom temperature

48.8° F. It also occurred at *Tuscarora* station 1, lat. 27° 7′ N., and long. 142° 7′ E. in 73 fathoms.

### CRISTELLARIA VARIABILIS Reuss.

Plate 36, figs. 1-3.

*Cristellaria variabilis* Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 369, pl. 46, figs. 15, 16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 541, pl. 68, figs. 11-16.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 224, pl. 44, fig. 12.—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 560, pl. 10, fig. 22.—Egger, Abh. kön. bay. Akad. Wiss., München, Cl. ii, vol. 18, 1893, p. 353, pl. 12, figs. 16-18.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 1894, p. 62, pl. 10, figs. 593-595.—Flint, Rep. U. S. Nat. Mus., p. 316, pl. 63, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1903, p. 256, pl. 5, fig. 1.

*Description.*—Test compressed, varying in form according to stage in development, early stages nearly circular, later becoming elliptical or oblong; chambers comparatively few, high and broad; surface smooth, sutures very slightly depressed, in adult specimens the periphery keeled; aperture in adults somewhat produced, the outer border irregularly dentate.

Length usually not much exceeding 1 mm.

*Distribution.*—Brady records this species from a single *Challenger* station, 232, on the *Hyalonema*-ground, south of Japan in 345 fathoms. I have had it from but four stations, *Albatross* stations off Japan, D4897, 207 fathoms, bottom temperature 49.7° F.; D4949, 110 fathoms, bottom temperature 57.8° F.; D4970 in 500 fathoms, bottom temperature 39.1° F.; and D5056 in Suruga Gulf, Japan, 258 fathoms, bottom temperature 46.0° F.

*Description.*—Test elongate, compressed, early chambers close coiled, later ones becoming uncoiled, elongate; sutures slightly depressed; wall smooth; periphery rounded, without a keel.

Length up to 3 mm.

*Distribution.*—Brady records this species from 40 fathoms off the coral reefs of Honolulu, Hawaiian Islands, and in the *Challenger* volume on "Summary of Results," it is also recorded from *Challenger* station 246 in 2,050 fathoms. Goës records it from two *Albatross* stations, D3375 and D3376, in 1,201 and 1,132 fathoms, respectively, in the eastern Pacific. Bagg records it at four *Albatross* stations in the vicinity of the Hawaiian Islands; D4000 in 104–213 fathoms; H4430 in 1,544 fathoms; H4508 in 495 fathoms; and H4694 in 865 fathoms.

I have had specimens from numerous *Nero* stations about the Hawaiian Islands, west of Midway Island, and between Guam and Japan, ranging in depth from 518 to 2,080 fathoms. Off the Galapagos I have had it from D2806 in 1,379 fathoms, and off Japan at the following stations: D4949, in 110 fathoms, bottom temperature 57.8° F.; D4966 in 290 fathoms, bottom temperature 44.1° F.; and D4967 in 244 fathoms, bottom temperature 45.9° F.

### CRISTELLARIA LATA (Cornuel).

Plate 35, fig. 4.

*Marginulina lata* Cornuel, Mém. Soc. géol. France, ser. 2, vol. 3, 1848, p. 252, pl. 1, figs. 34–37.

*Planularia pauperata* Jones and Parker, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 454, pl. 20, fig. 39.—H. B. Brady, Proc. Somerset Arch. and Nat. Hist. Soc., vol. 13, 1867, p. 110, pl. 2, figs. 24, 25.

*Cristellaria lata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 539, pl. 67, fig. 18*a*, *b*.

*Description.*—Test broad, subtriangular in side view, much compressed, early chambers somewhat close coiled, later ones very elongate and uncoiling, sutures very slightly depressed, oblique, wall smooth, aperture somewhat produced, radiate.

Length up to 2 mm.

*Distribution.*—This species has been previously unrecorded from the North Pacific. I have had specimens from the three following stations, *Albatross* D4843, in 100 fathoms, bottom temperature 39.9° F., off Japan, and *Tuscarora* 11, in 437 fathoms, lat. 33° 46′ N.; long. 140° 21′ E. and *Tuscarora* 126, in 500 fathoms, lat. 54° 08′ N.; long. 161° 31′ W.

This species seems to be a broadened development of a form like *C. crepidula*, but seems to have characters which make it distinct from that species.

### CRISTELLARIA TRICARINELLA Reuss.

Plate 34, figs. 1, 2.

*Cristellaria tricarinella* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p 68, pl. 7, fig. 9; pl. 12, figs. 2–4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 540, pl. 68, figs. 3, 4.

*Description.*—Test elongate, greatly compressed; earliest chambers close coiled, following ones soon becoming elongate, but extending back to the previous coil, giving an elongate subtriangular form to the later developed portion, sutures limbate; periphery of the test with a flange-like keel at each side, the border between them concave or with a median raised keel in addition to the lateral ones, wall unornamented except for the limbate sutures and keeled periphery.

Length 1.5–2 mm.

*Distribution.*—Brady records this species in the North Pacific from one *Challenger* station off the Philippines in 95 fathoms. The only North Pacific stations from which I have had material are *Albatross* D4840 in 154 fathoms, bottom temperature 39.9° F., and D4900 in 139 fathoms, bottom temperature 52.9° F., off Japan. This is the same region from which so many southern species seem to reach their northern limits, that it is not surprising to find this species there, which is really from its distribution a species of tropical waters.

### CRISTELLARIA TRICARINELLA Reuss, var. SPINIPES, new variety.

Plate 33, fig. 2.

*Description.*—Like the typical but the early chambers of the close coiled portion showing limbate sutures and the apical end of the test bearing a large stout spine.

*Description.*—Test close coiled, biconvex, umbonate; wall smooth, sutures distinct but hardly, if at all, depressed; periphery of test acute, with a distinct carina of greater or less width, with a long acicular spine opposite each chamber.

Length without spines about 1 mm.

*Distribution.*—Brady records this species from a single *Challenger* station in the North Pacific, 95 fathoms off the Philippines. Bagg records it from an *Albatross* station D4000 in 104 to 213 fathoms off the Hawaiian Islands. I have had specimens from one *Albatross* station H2922 in 268 fathoms and *Nero* station 2071 in 271 fathoms off the Hawaiian Islands and from several stations off Japan, depths ranging from 37 to 139 fathoms and bottom temperatures from 52.9° to 66.6° F. It is interesting to note that one of these stations, D4900, is one from which so many species recorded by Brady from the Philippines have been obtained.

From the above data the distribution of this species in the North Pacific at least seems to be largely in comparatively shallow, warm waters.

There seem to be two distinct forms at least which are included under this specific name. One of these is small in size, of comparatively few chambers in each whorl and with a few long acicular spines radially placed, the peripheral carina being narrow. The other is of much larger size, with many more chambers in each whorl and with many short broad flattened spinose projections extending somewhat backward from the wide peripheral carina and appearing as projections of the carina rather than as distinct spines.

The small form with the long acicular spines is the only one which I have seen in the North Pacific material. The synonymy is not clear on these two forms and it will be interesting to see if these are not really distinct from one another. The figures given by Flint show well the contrast in size and other characters between these two forms.

### CRISTELLARIA ECHINATA (d'Orbigny).

Plate 34, fig. 5.

"Nautili Echinati" etc. Soldani, Testaceographia, vol. 1, pt. 1, 1789, p. 65, pl. 59, figs. *qq*, *rr*.

*Nautilus calcar*, var. e, Fichtel and Moll, Test. Micr., 1803, p. 74, pl. 12, figs. *a*, *b*, *c*.

*Robulina echinata* d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 100, pl. 4, figs. 21, 22.

*Cristellaria* (*Robulina*) *echinata* Carpenter, Parker, and Jones, Intr. Foram., 1862, pl. 12, fig. 3.

*Cristellaria echinata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 554, pl. 71, figs. 1-3.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 318, pl. 66, fig. 2.

*Description.*—Test close coiled, composed of comparatively few chambers, biconvex, umbonate; sutures limbate, in the earlier development tending to break up into a series of raised rounded bosses, the largest near the umbo and thence diminishing in size toward the periphery, in the last-formed chambers the whole becoming a single raised ridge; wall between the sutures in the earlier development closely set with small raised papillæ becoming less numerous or wanting on the later-formed chambers; periphery with a slight keel and each chamber with a long acicular spine.

Length without spines about 2 mm.

*Distribution.*—The only North Pacific record for this beautiful species is that given by Brady, a single *Challenger* station off the Philippines in 95 fathoms.

This species combines many of the characters of *C. calcar* and *C. papillosa.*

### CRISTELLARIA PAPILLOSA (Fichtel and Moll).

Plate 37, fig. 2.

*Nautilus papillosus* Fichtel and Moll, Test. Micr., 1803, p. 82, pl. 14, figs. *a-c.*
*Cristellaria papillosa* Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 113, No. 17.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 553, pl. 70, fig. 16.

*Description.*—Test close coiled, composed of numerous chambers, peripheral margin acute but not distinctly carinate; biconvex, sutures limbate, the thickenings developing into a series of rounded knobs, largest near the umbo and gradually decreasing in size toward the periphery; the wall in the earlier development between the sutures is more or less covered with fine raised papillæ, but these are not developed in the last-formed chambers.

fathoms, bottom temperature 52.9° F. This is another example of the extension of the species recorded by Brady from the Philippines to southern Japan at this particular station.

### CRISTELLARIA DENTICULIFERA, new species.

Plate 37, fig. 1.

*Cristellaria cultrata* H. B. BRADY (part) (not *C. cultrata* Montfort), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 550, pl. 70, figs. 7, 8.

*Description.*—Test close coiled, biconvex, sutures somewhat limbate; wall of earlier chambers ornamented with longitudinal curved costæ often broken up into irregular tubercles; later chambers smooth and unornamented; peripheral border keeled, but the outer edge broken up into a series of tooth-like projections.

Length up to 2.5 mm.

*Type-specimen.*—Cat. No. 8547, U.S.N.M., from *Albatross* station D4900 in 139 fathoms, bottom temperature 52.9° F. off Japan.

This certainly seems to be a different species from typical *C. cultrata*. It differs in the limbate sutures, the smaller number of chambers in the coil, the surface ornamentation, and the denticulate character of the peripheral keel.

### CRISTELLARIA GEMMATA H. B. Brady.

Plate 34, fig. 7.

*Cristellaria gemmata* H. B. BRADY, Quart. Journ. Micr. Soc., vol. 21, 1881, p. 64, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 554, pl. 71, figs. 6, 7.

*Description.*—"Test planospiral, broad, oblong, compressed or complanate; lateral faces only slightly convex, dorsal edge acute or subcarinate; segments broad and arcuate, two or three of later ones free at both lateral margins; exterior ornamented with exogenous beads, arranged either upon the sutural lines, or, less frequently, in rows parallel to them."

"Length 1/20th inch (1.26 mm.)."

*Distribution.*—The only North Pacific record for this species is that given by Brady, a *Challenger* station off the Philippines in 95 fathoms.

### CRISTELLARIA COSTATA (Fichtel and Moll).

Plate 34, fig. 4.

*Nautilus costatus* FICHTEL and MOLL, Test. Micr., 1803, p. 47, pl. 4, figs. *g–i*.
*Spincterules costatus* MONTFORT, Conch. Syst., 1808, p. 222, genre 56°.
*Lenticulina costata* DE FRANCE, Dict. Sci. Nat., vol. 32, 1824, p. 182.
*Robulina costata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 289, No. 13 [?].
*Cristellaria costata* PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 113, No. 19.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 555, pl. 71, figs. 8, 9.

*Description.*—Test close coiled, chambers comparatively few to each volution, sutures limbate; surface ornamented by numerous stout costæ in general parallel with the periphery of the test; apertural angle decidedly acute.

Length about 1 mm.

*Distribution.*—This species has not previously been reported from the North Pacific. The only material I have seen is from *Nero* station 203 in 1,625 fathoms, bottom temperature 35° F., west of Midway Islands.

This is a remarkable occurrence for this species, which by its previous recorded distribution seems to have been taken in comparatively warm and shallow water.

### CRISTELLARIA ELEGANTISSIMA (Costa).

Plate 36, fig. 7.

*Robulina elegantissima* Costa, Atti Accad. Pont., vol. 7, pt. 2, 1856, p. 198, pl. 19, fig. 4.

*Cristellaria elegantissima* Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 64, pl. 11, figs. 641, 642.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 147.

*Description.*—Test compressed with the earlier development close coiled, later chambers elongate, taking on a tendency toward uncoiling, early chambers ornamented with closely set, rather acute costæ, parallel to the periphery of the test, sutures indistinct, not limbate; later chambers smooth, ornamentation persisting longest on the periphery; peripheral border with a narrow but very distinct keel; apertural angle prominent.

Length about 1.25 mm.

*Distribution.*—Bagg records this species from a single *Albatross* station, H4508, in 495 fathoms off the Hawaiian Islands. This specimen I have examined and it is here figured.

This species differs from *C. costata* in the form of the test and in the ornamentation which here is close set and rather acute while in *C. costata* the costæ are coarser and rounded.

### CRISTELLARIA WETHERELLII Jones, var. SUBLINEATA, new variety.

Plate 33, fig. 4.

*Description.*—Test at first close coiled, later becoming uncoiled and crozier-shaped; curved; compressed, sutures depressed, portion of chamber wall between the sutures ornamented with rows of tubercles in linear rows both transversely and longitudinally, in later growth tending to fuse into a raised ridge.

Length about 5 mm.

*Type-specimen.*—Cat. No. 8548, U.S.N.M., from *Albatross* station D4900 in 139 fathoms, bottom temperature 52.9° F., off Japan. This is the first occurrence of this species in the North Pacific, and

### CRISTELLARIA SUBALATA H. B. Brady.

Plate 30, figs. 5–7.

*Cristellaria obtusata* Reuss, var. *subalata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 536, pl. 66, figs. 24, 25.

*Cristellaria subarcuatula* Goës (part, not *C. subarcuatula* Montagu), Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 57.

*Description.*—Test much elongated, earliest chambers close coiled, later ones very early becoming uncoiled and developing an elongate, compressed test, with oblique, slightly depressed sutures; wall smooth; initial end of the test, with a broad flaring plate-like keel, not extending up the peripheral margin, or at least only slightly, bearing numerous concentric lines of growth and usually with radial markings as well; aperture radiate, terminal.

Length up to 5 mm.

*Distribution.*—Under the name *C. subarcuatula* Goës has recorded this species from two stations in the eastern North Pacific, *Albatross* D3375, 1,201 fathoms, and D3407 in 885 fathoms.

An examination of Goës's specimens from these stations shows them to be of the form here figured rather than that shown[1] by Goës, who simply used as illustrations copies of his figures in the "Report upon the Arctic and Scandinavian Foraminifera" previously published.[2] In reality the specimens found by Goës at these North Pacific stations as is shown by Goës's own material are identical with the form figured by Brady in the *Challenger* Report as noted above. In many of its characters this form seems worthy of specific rank and its relation to *C. obtusata* Reuss is very doubtful. I have taken the liberty of raising it to specific rank.

### CRISTELLARIA SCHLOENBACHI Reuss.

Plate 36, fig. 6.

*Cristellaria schloenbachi* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p. 65, pl. 6, figs. 14, 15.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 539, pl. 67, fig. 7.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 315, pl. 63, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1903, p. 253.

*Description.*—Test much elongate, compressed, early portion close coiled for a few chambers, then gradually assuming an uncoiled straight form, but with the sutures oblique, the chambers high; surface smooth, sutures slightly depressed, peripheral border rounded; aperture terminal, radiate.

Length about 2 to 2.5 mm.

*Distribution.*—Although not previously recorded from the North Pacific, the species occurred at *Albatross* station D4875 in 59 fathoms, eastern channel of Korea Strait.

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[1] Bull. Mus. Comp. Zoöl., vol. 29, 1896, pl. 5, figs. 19–24.

[2] Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 63, pl. 11, figs. 630–637.

### CRISTELLARIA LATIFRONS H. B. Brady.

Plate 38, fig. 2.

*Cristellaria latifrons* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 544, pl. 68, fig. 19; pl. 113, fig. 11*a*, *b*.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 316, pl. 63, fig. 3.

*Description.*—Test elongate, tapering toward either end, triangular in transverse section; early chambers close coiled, later ones uncoiling elongate, very broad on the inner face, each chamber extending well back toward the preceding coil, its marginal angles acute or obtusely rounded, peripheral margin of the test angular.

Length 0.6 to 1.5 mm.

*Distribution.*—This species has not previously been recorded from the North Pacific. The only station from which I have had material is *Albatross* D4966 in 290 fathoms, bottom temperature 44.1° F., off Japan. The material was very typical.

In the form of the chambers this is very different from *C. italica*, in which the chambers are shorter and do not extend back to the initial whorl.

### CRISTELLARIA ITALICA (De France).

Plate 33, fig. 3.

*Saracenaria italica* De France, Dict. Sci. Nat., vol. 32, 1824, p. 177; vol. 47, 1827, p. 344; Atlas Conch., pl. 13, fig. 6.—Blainville, Man. de Mal., 1825, p. 370, pl. 5, fig. 6.

*Cristellaria* (*Saracenaria*) *italica* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 293, No. 26; Modèles, Nos. 19 and 85.

*Cristellaria italica* Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3,

## Genus MARGINULINA d'Orbigny, 1826.

*Marginulina* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 258 (type, *M. glabra* d'Orbigny).—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 526.

*Description.*—Test subcylindrical, early portion close coiled, later chambers uncoiled, rounded in transverse section, last formed chambers often inflated; aperture in early chambers marginal, later often becoming nearly median, usually radiate.

This genus is not well characterized, and the limits between it and the much uncoiled species of *Cristellaria* are not at all well defined.

### MARGINULINA GLABRA d'Orbigny.

Plate 23, fig. 3.

*Marginulina glabra* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 259, No. 6; Modèles, No. 55.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 27, pl. 1, fig. 36.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 527, pl. 65, figs. 5, 6.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 344, pl. 12, figs. 24, 25.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 346, pl. 11, figs. 28, 29.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 313, pl. 60, fig. 1.

*Vaginulina glabra* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 59.

*Description.*—Test short, stout, early chambers close coiled, later ones uncoiled, subcylindrical, inflated, sutures depressed, surface smooth; aperture usually radiate.

Length up to 2.5 mm.

*Distribution.*—Brady records this species from two *Challenger* stations in the North Pacific off Japan in 345 and 2,150 fathoms. Goës records it from *Albatross* station D3376 in 1,132 fathoms off the west coast of America. I have found it but very rarely in the material I have examined.

### MARGINULINA STRIATULA, new species.

Plate 23, fig. 4.

*Description.*—Test elongate, early part forming a portion of a coil, later chambers moniliform, tumid, separated by deep constrictions; wall with numerous very fine longitudinal striæ; aperture at the end of a well developed neck, four-radiate.

Length nearly 2 mm.

*Type-specimen.*—Cat. No. 8549, U.S.N.M., from *Nero* station 2071 in 271 fathoms off the Hawaiian Islands.

The finely striate surface and the apertural characters will easily distinguish the species.

## Genus VAGINULINA d'Orbigny, 1826.

*Vaginulina* D'ORBIGNY (type *V. legumen* Linnæus), Ann. Sci. Nat., vol. 7, 1826, p. 257.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 529.

*Description.*—Test elongate, chambers in a linear series, placed so that the sutures are oblique, aperture marginal, chambers laterally compressed.

The genus *Vaginulina* is a more or less convenient one for certain compressed forms which have, in common, oblique sutures and a marginal aperture. Among the fossil forms this genus has no definite position, but its place as a genus, including recent species, is not a very stable one.

### VAGINULINA LEGUMEN (Linnæus)

Plate 39, fig. 4.

*Nautilus legumen* LINNÆUS, Syst. Nat., ed. 10, 1758, p. 711, No. 248; ed. 12, 1767, p. 1164, No. 288.

*Vaginulina legumen* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 257, No. 2.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 530, pl. 66, figs. 13–15.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 58.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 314, pl. 60, fig. 2.—BAGG, Proc. U.S. Nat. Mus., vol. 34, 1908, p. 145.

*Description.*—Test compressed laterally, composed of several chambers, sutures distinct, often the wall below being translucent, earlier not distinguishable in contour, later ones often somewhat tumid and distinguishable, length of individual chamber variable; initial end with or without a spine; wall smooth and polished, aperture marginal on a somewhat extended neck, radiate.

Segments about 12 in number; long, narrow, slightly bent; obliquely set or nearly erect."

"Length $\frac{1}{35}$ inch (0.74 mm.)."

*Distribution.*—Described and figured by Brady from specimens dredged by the *Challenger* in 95 fathoms off the Philippines. The specimens figured by Egger seem rather doubtfully the same as Brady's, but the figures lack detail.

### VAGINULINA PROTUMIDA (Schwager).

Plate 30, fig. 1.

*Nodosaria protumida* SCHWAGER, *Novara* Exped., Geol. Theil. vol. 2, 1866, p. 227, pl. 6, fig. 59.

*Description.*—Test elongate, tapering, arcuate, early chambers somewhat oblique, sutures indistinct, later chambers much inflated; wall ornamented with numerous longitudinal raised costæ, increasing in number as chambers are added; apical portion very tapering; aperture at the end of a long slender neck.

Length about 3 mm.

*Distribution.*—Schwager described this species from the Tertiary of Kar Nicobar. The figured specimen is from *Albatross* station D4966, off Japan in 290 fathoms, bottom temperature 44.1° F.

Evidently this belongs to *Vaginulina* rather than *Nodosaria*. The apertural neck in the figured specimen is broken, but otherwise it agrees very well with Schwager's figure.

## Genus FRONDICULARIA De France, 1824.

*Frondicularia* DE FRANCE (type, *F. complanata* De France), Dict. Sci. Nat., vol. 32, 1824, p. 178.

*Description.*—Test compressed, in the adult consisting of chambers, elongate and narrow, running back on either side of the test; wall vitreous, finely perforate; aperture single, either radiate or surrounded with a lip which is usually cut in a radial manner; surface smooth or ornamented with costæ; microspheric specimens with a coiled development in the earlier chambers; megalospheric specimens without the coiled chambers as a rule.

The genus *Frondicularia* is interesting in showing very clearly the differences between the microspheric and megalospheric forms in the same species. Formerly the coiled microspheric forms were called *Flabellina*, but it has been shown that instead of generic differences these early stages represent the complete phylogenetic development seen in so many species only in the microspheric form. In the megalospheric form with its much larger proloculum the coiled chambers are few or are not developed at all. This difference in the development is shown in the accompanying outline figures.

As a fossil genus *Frondicularia* is very well represented from the Triassic onward, being very abundant, both in number of species and individuals in some horizons. In the present ocean, except in certain restricted regions, it is almost unknown. There are but few living species

### FRONDICULARIA BRADYI, new name.

Plate 23, fig. 5; plate 39, fig. 5.

*Frondicularia spathulata* H. B. BRADY (not *F. spathulata* Williamson) Quart. Journ. Micr. Sci., vol. 19, 1879, p. 56, pl. 8, figs. 5*a*, *b*; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 519, pl. 65, fig. 18.—SIDEBOTTOM, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 5, pl. 1, fig. 26.

*Description.*—Test elongate, compressed, narrow; chambers comparatively few in number, proloculum largest, elliptical, more rotund than the later chambers; chambers following the proloculum reflexed; those of the later development often less so; aperture terminal, elliptical; sutures slightly depressed; surface smooth.

Length about 0.5 mm.

*Distribution.*—Brady obtained material of this species from off the Ki Islands, 129 fathoms, and off Raine Island, 155 fathoms. In the *Challenger* Report, page 520, he also mentions the only North Pacific record, as follows: "Mr. F. W. Millett has the same from the coast of Korea, 40 fathoms." Sidebottom records the species from the coast of the island of Delos (Grecian Archipelago) as very rare. His specimen from the Bay of Palermo and Egger's single specimen from the Gazelle expedition, both of which are referred to this species, would seem best referred to *F. nitida* Terquem, as Millett has already

*Distribution.*—Brady described this species from specimens from two localities: Off the Ki Islands, southwest of New Guinea, 129 fathoms, and on the coral reefs of Honolulu, Hawaiian Islands, 40 fathoms.

The species is a peculiar one in many respects, the ornamentation suggesting many of the Tertiary species, but the thickened form and broad rounded edges being distinct.

The figures and description are from Brady.

### FRONDICULARIA ROBUSTA H. B. Brady, var. REPANDA, new variety.

Plate 29, figs. 1, 2.

*Frondicularia robusta* BAGG (not *F. robusta* H. B. Brady), Proc. U. S. Nat. Mus., vol. 34, 1908, p. 145.

*Description.*—Test compressed, broad, later chambers extending backward, giving the test a broadly fan-shaped form; otherwise like *F. robusta* H. B. Brady.

Length up to 2.5 mm.

*Distribution.*—Bagg's specimen is of this broad flaring form, found at *Albatross* station D4508 in 495 fathoms off the Hawaiian Islands. I have seen specimens which are here figured from *Albatross* stations H4881 (type-locality) in 316 fathoms and D4922 in 60 fathoms, off the southern part of Japan.

*Type-specimen.*—Cat. No. 8550, U.S.N.M.

This variety lacks the form of the typical, but has the same general character of ornamentation and rounded borders.

## Subfamily 3. POLYMORPHININÆ.

Test polythalamous; chambers arranged either biserially or in an irregular spiral; surface smooth or variously ornamented; aperture usually radiate.

This subfamily includes the genus *Polymorphina* and its closely allied form *Dimorphina*.

### Genus POLYMORPHINA d'Orbigny, 1826.

*Polymorphina* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 265.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 557.

*Description.*—Test more or less rounded, usually not equilateral, chambers few, obliquely placed in a more or less spiral arrangement; aperture terminal, usually radiate; wall calcareous, perforate, either smooth or variously ornamented with spines, costæ, or tubercles.

Although there are various modifications of *Polymorphina*, the unity of the whole is very well defined, the aperture is usually radiate and the modifications are largely along the lines of ornamentation and the arrangement, number, and form of the chambers.

### POLYMORPHINA LACTEA (Walker and Jacob).

Plate 34, fig. 8.

"Serpula tenuis ovalis laevis" Walker and Boys, Test. Min., 1784, p. 2, pl. 1, fig. 5.

"Polymorpha Subcordiformia vel Oviformia" Soldani, Testaceographia, vol. 1, pt. 2, 1791, p. 114, pl. 112, figs. 11, *nn*, etc.

*Serpula lactea* Walker and Jacob, Adams' Essays, ed. 2, 1798, p. 634, pl. 24, fig. 4.

*Vermiculum lacteum* Montagu, Test. Brit., 1803, p. 522.

*Polymorphina lactea* Magillivray, Moll. Aberd., 1843, p. 320.—Williamson (part) Rec. For. Great Britain, 1858, p. 71, pl. 6, fig. 147.—H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, p. 213, pl. 39, fig. 1 *a–c*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 559, pl. 71, fig. 11.—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 561, pl. 11, fig. 9.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 486.—Crick and Sherborn, Journ. Northampton Nat. Hist. Soc., vol. 7, 1892, p. 71, fig. 25.—Egger, Abh. kön. bay. Acad. Wiss. München, vol. 18, 1893, p. 308, pl. 9, figs. 8, 14, 15.—Chapman, Journ. Roy. Micr. Soc., 1896, p. 9, pl. 2, fig. 3.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 119, pl. 1, fig. 7.—Millett, Journ. Roy. Micr. Soc., 1903, p. 261.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 9, pl. 2, fig. 11 [?].—Chapman, Journ. Quekett Micr. Club, 1907, p. 131.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 149.

*Description.*—Test ovate, nearly symmetrical in transverse section, chambers few, elongate, separated by slightly depressed sutures; wall smooth.

Length about 0.5 mm.

*Distribution.*—This species was recorded by Brady from one *Challenger* station in the North Pacific, depth 2,300 fathoms, and by Bagg from *Albatross* station H4579 in 387 fathoms, off the Hawaiian than either of the other two specimens to which reference is given above. The earlier portion, however, is similar to *Polymorphina lactea*.

### POLYMORPHINA AMYGDALOIDES Reuss.

Plate 41, fig. 5.

*Globulina amygdaloides* Reuss, Zeitschr. d. deutsch. geol. Ges., vol. 3, 1851, p. 82, pl. 6, fig. 47.

*Polymorphina amygdaloides* Reuss, Sitz. Kais. Akad. Wiss. Wien, vol. 18, 1855, p. 250, pl. 8, fig. 84.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 561, pl. 71, fig. 13.—Burrows and Holland, Proc. Geol. Assoc., vol. 15, 1897, p. 46, pl. 2, fig. 18.—Millett, Journ. Roy. Micr. Soc., 1903, p. 261.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 9, pl. 2, figs. 12–14.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 148.

*Polymorphina lactea* Walker and Jacob, var. *amygdaloides* H. B. Brady, Parker, and Jones, Trans. Linn Soc. London, vol. 27, 1870, p. 214, wood cuts.

*Description.*—Test oval, somewhat compressed, cross-section eliptical, chambers few, elongate, sutures only very slightly depressed; wall smooth.

Length 0.6 to 1 mm.

*Distribution.*—Bagg records the species from three *Albatross* stations in the vicinity of the Hawaiian Islands, D4017, 305 fathoms; D4174, 735–865 fathoms; and H4567, in 1,307 fathoms.

I have found no material to place in this species. The figures are drawn from the specimens recorded by Bagg.

### POLYMORPHINA GIBBA d'Orbigny.

Plate 41, fig. 4.

"Polymorphina Subcordiformia vel Oviformia" Soldani, Testaceographia, vol. 1 to 2, 1791, p. 114, vol. 113, figs. *zz*, *C*, etc.

*Polymorphia (Globulina) gibba* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 226, No. 20; Modèles, No. 63.—Egger, Neues Jahrb. für Min., 1857, p. 288, pl. 13, figs. 1–4.

*Polymorphina gibba* H. B. Brady, Parker, and Jones (part), Trans. Linn. Soc. London, vol. 27, 1870, p. 216, pl. 39, figs. 2*a*–*d*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 561, pl. 71, figs. 12*a*, *b*.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 486.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 10, pl. 2, figs. 15–17.—Chapman, Journ. Quekett Micr. Club, 1907, p. 131.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 149.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 279.

*Globulina gibba* d'Orbigny, For. Foss. Vienne, 1846, p. 227, pl. 13, figs. 13, 14.

*Description.*—Test rotund, front view nearly circular, end view broadly oval; visible chambers few; broad sutures slightly excavated; wall smooth, aperture somewhat produced.

Length 0.75 to 1 mm.

*Distribution.*—Bagg records this species from one station only, *Albatross* H4430, rarely, in 1,544 fathoms, off the Hawaiian Islands. The specimen I have examined, and it is typical. I have a single specimen from *Albatross* D4807, in 44 fathoms, off Japan.

### POLYMORPHINA ANGUSTA Egger.

Plate 39, fig. 6.

*Polymorphina (Globulina) angusta* Egger, Neues Jahrb. für Min., 1857, p. 290, pl. 13, figs. 13–15.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 563, pl. 72, figs. 1–3.

*Description.*—Test elongate, compressed, cylindrical, apical end acute and subacute, apertural end obtuse, chambers comparatively few, elongate, sutures but very slightly depressed; wall smooth, aperture finely radiate.

Length 0.6 to 0.8 mm.

*Distribution.*—Brady records this species from one *Challenger* station in the North Pacific, station 241, in 2,300 fathoms. Bagg also records it in another, Hawaiian Islands, *Albatross* D4017, in 305 fathoms. Bagg's specimen which I have examined seems more like a *Quinqueloculina* than a *Polymorphina*, but it is too poor to make out surely. I have had specimens from three *Nero* stations, 170, northwest of the Hawaiian Islands toward Midway Island, 1,990 fathoms; station 1300 in 1,088 fathoms, and 1301 in 1,529 fathoms, both south of Japan.

### POLYMORPHINA LANCEOLATA Reuss.

Plate 40, fig. 2.

*Polymorphina lanceolata* Reuss, Zeitschr. d. deutsch. geol. Ges., vol. 3, 1851, p. 83, pl. 6, fig. 50; Sitz. kais. Akad. Wiss. Wien, vol. 62, 1870, p. 487, No. 12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 564, pl. 72, figs. 5-6.

*Polymorphina fusiformis* H. B. Brady, Parker, and Jones (part), Trans. Linn. Soc. London, vol. 27, 1870, p. 219, pl. 39, figs. 5*b*, *c*.

### POLYMORPHINA COMMUNIS d'Orbigny.

Plate 37, fig. 7.

*Polymorphina (Guttulina) communis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 266, pl. 12, figs. 1–4; Modèles, No. 62.—EGGER, Neues Jahrb., 1857, p. 288, pl. 13, figs. 16–18.

*Polymorphina communis* H. B. BRADY, PARKER, and JONES, Trans. Linn. Soc. London, vol. 27, 1870, pl. 39, p. 224, figs. 10*a*, *b*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 568, pl. 72, fig. 19.—BURROWS and HOLLAND, Proc. Geol. Ass., vol. 15, 1897, p. 46, pl. 2, fig. 14.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 2.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 263.—CHAPMAN, Journ. Quekett Micr. Club, 1907, p. 131.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 11.

*Description.*—Test ovate, somewhat elongate, initial end broadly rounded, apertural end somewhat obliquely pointed; chambers few, inflated, sutures excavated; wall smooth.

Length 0.75 to 1 mm.

*Distribution.*—This species is recorded by Flint from *Albatross* station 2842 in 72 fathoms off Unalaska. Bagg records it from the Hawaiian Islands, but I am inclined, after examination, to place his specimens under *Polymorphina sororia.* I have seen specimens from *Tuscarora* station 11, in 437 fathoms in the eastern Pacific, and *Albatross* H4856 in 898 fathoms in Bering Sea. This species has more or less tumid chambers and a rounded initial end but is variable.

### POLYMORPHINA OVATA d'Orbigny.

Plate 30, fig. 2.

*Polymorphina ovata* D'ORBIGNY, For. Foss. Vienne, 1846, p. 233, pl. 13, figs. 1–3.—REUSS, Sitz. kön. Akad. Wien, vol. 55, 1867, p. 91.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 564, pl. 72, figs. 7, 8.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 54.

*Description.*—"The test of this species has an oval but somewhat inequilateral outline and the two faces are almost equally convex; the oral end is obtuse, the aboral acuminate. The segments are arranged with regularity in two alternating series, the last pair occupying two-thirds of the visible shell. The sutures are complinate and are marked by fine lines without external depressions." Description copied from Brady.

*Distribution.*—Goës records this species as rare from *Albatross* tation 3407 in 885 fathoms. This specimen is here figured.

### POLYMORPHINA OVATA d'Orbigny, fistulose form.

Plate 40, fig. 4.

A specimen with long branching last-formed chambers was found n material from the Gulf of Sidra. The early chambers seem to be llied to *Polymorphina ovata.* It is an exceptionally branching and xtended form.

### POLYMORPHINA OBLONGA d'Orbigny.

Plate 37, fig. 6.

*Polymorphina oblonga* d'Orbigny, For. Foss. Vienne, 1846, p. 232, pl. 12, figs. 29–31.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 569, pl. 73, figs. 2–4.—Chaster, First Rep. Southport, Soc. Nat. Sci., 1890-91 (1892), p. 64, pl. 1, fig. 13.—Egger, Abh. kön. bay. Acad. Wiss. München, Cl. ii, vol. 18, 1893, p. 309, pl. 11, figs. 9, 10, 24.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1903, p. 164.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 12, pl. 2, fig. 20.—Chapman, Journ. Quekett Micr. Club, 1907, p. 132; Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 280.

*Description.*—"The test is more or less compressed, and has six to eight visible segments which are somewhat oblong and inflated in contour and separated by excavated sutures."

Brady records this species from the North Pacific down to 2,050 fathoms. The species is recorded by Bagg, but an examination of his specimens show it to be an *Uvigerina* with a phialine lip on the opposite end from which the aperture would be if the specimen were a *Polymorphina* of this species. The description and figure are from Brady.

### POLYMORPHINA ROTUNDATA (Bornemann).

Plate 40, fig. 1.

*Guttulina rotundata* Bornemann, Zeitschr. d. deutsch. geol. Ges., vol. 7, 1855, p. 346, pl. 18, fig. 3.

*Polymorphina rotundata* Reuss, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 487, No. 14.—von Schlicht, Foram. Pietzpuhl, 1870, pl. 26, figs. 13–15; pl. 28, figs. 1–5; pl. 30, figs. 33–40.—H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, p. 234, p. 40, fig. 19*a–e* and wood cuts.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 570, pl. 73, figs. 5-8.

Length 0.6 to 0.8 mm.

*Distribution.*—This species is recorded by Picaglia from long. 09° 58′ W.; lat. 0° 47′ N. in 4,670 meters.

Bagg's specimens referred by him to *Polymorphina communis* seem more properly to be placed here. His specimens are figured. They are from *Albatross* station H4585 in 689 fathoms near the Hawaiian Islands.

### POLYMORPHINA COMPRESSA d'Orbigny.

Plate 40, fig. 3.

Polymorpha "Subovalia" Soldani, Testaceographia, vol. 1, pt. 2, 1791, p. 114, pl. 114, fig. F, I; pl. 115, fig. N; pl. 116, figs. V, X, etc.

*Polymorphina compressa* d'Orbigny, For. Foss. Vienne, 1846, p. 233, pl. 12, figs. 32–34.—H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, p. 227, pl. 40, figs. 12*a–f*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 565, pl. 72, figs. 9–11.—Mariani, Boll. Soc. Geol. Italia, vol. 7, 1888, p. 288, pl. 10, fig. 13.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Acad. Wiss. München, Cl. ii, vol. 18, 1893, p. 309, pl. 9, figs. 11–13.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 58, pl. 10, figs. 539–553.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 3.—Millett, Journ. Roy. Micr. Soc., 1903, p. 262.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 13, pl. 3, figs. 1–6, 12, 13 [?].—Bagg, U. S. Nat. Mus., vol. 34, 1908, p. 149.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 280.

*Description.*—Test usually oblong, strongly compressed, chambers numerous, elongate, but often as broad as long in surface view except the last, in an alternating biserial arrangement, sutures somewhat excavated, surface somewhat smooth, but occasionally with traces of striæ near the initial end; aperture strongly radiate, often on a protuberant portion of chamber.

Length up to 3.15 mm.

*Distribution.*—Brady records this species from the North Pacific without station. Bagg records it from three stations off the Hawaiian Islands, D4017, 305 fathoms, H4430 in 1,544 fathoms, and H4694 in 865 fathoms. Of the two specimens of the Bagg material in Washington which I have examined, the specimen from D4017 is definitely a *Quinqueloculina* and that from H4694 too broken to determine.

Excellent specimens of this species were obtained from material dredged at *Albatross* station H4878 in 84 fathoms and D4825 in 120 fathoms, adjacent stations off the coast of Japan.

This seems to be a more clearly defined species than most of the others of the genus.

### POLYMORPHINA ELEGANTISSIMA Parker and Jones.

Plate 38, fig. 1.

*Polymorphina elegantissima* Parker and Jones, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 438.—H. B. Brady, Parker, and Jones, Trans. Linn. Soc., vol. 27, 1870, p. 231, pl. 40, fig. 15*a–c*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 566, pl. 72, figs. 12–15.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1893, p. 263.—Chapman, Journ. Quekett Micr. Club, 1907, p. 132, pl. 10, fig. 3; Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 280.

*Description.*—Test ovate, initial end broad and rounded, apical end tapering, bluntly pointed, end view often subtriangular; chambers few but unequally biserial; wall smooth, sutures not depressed but of a darker color; aperture radiate, prolonged.

Length up to 1 mm.

*Distribution.*—This is evidently a tropical or subtropical species of comparatively shallow waters. It has been obtained in the Australian and the East Indian region. In the North Pacific Brady records it from Hongkong Harbor, 7 fathoms. I have had specimens collected from the Inland Sea of Japan, depth not given.

The arrangement of chambers in this species is peculiar for the genus, the biserial arrangement being oblique, so that the last-formed chamber on one side of the test covers all previously added chambers of that side and on the other side leaves the other set exposed. In this way there are a number of chambers visible from either side of the test.

### POLYMORPHINA LONGICOLLIS H. B. Brady.

Plate 41, figs. 1–3.

### POLYMORPHINA REGINA H. B. Brady, Parker, and Jones.

Plate 41, figs. 6, 7.

*Polymorphina regina* H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, p. 241, pl. 41, figs. 32*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 571, pl. 73, figs. 11–13.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ɪɪ, vol. 18, 1893, p. 310, pl. 9, figs. 45, 50, 51.—Millett, Journ. Roy. Micr. Soc., 1903, p. 265.—Chapman, Journ. Quekett Micr. Club, 1907, p. 132, pl. 10, fig. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 149.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 281.

*Description.*—Test fusiform; chambers several, inflated, with deep sutures; wall ornamented with elongate, coarse costæ, usually not broken on the individual chambers; aperture radiate, produced.

Length 0.60 to 1 mm.

*Distribution.*—The only records for this species in the North Pacific are from the region of the Hawaiian Islands. Brady found it in the *Challenger* material from off Honolula in 40 fathoms. Bagg records it from *Albatross* station H4694 in 865 fathoms as rare, and I have found it in material from *Albatross* station H2922 in 268 fathoms. It seems to be a tropical species of comparatively shallow water.

## Subfamily 4. UVIGERININÆ.

Test composed of several chambers, typically spirally arranged, especially in the earlier portion, later chambers often becoming loosely arranged, or even uniserial; wall smooth or variously ornamented; aperture typically consisting of a neck with a definite phialine lip.

In *Uvigerina* the spirally arranged chambers are typical, old age characters appearing in the loss of ornamentation or in the tendency to become loosely spiral as in *U. interrupta*. In *Siphogenerina* the early chambers are spiral or biserial, especially well developed in the microspheric forms, and the later development is uniserial.

### Genus UVIGERINA d'Orbigny, 1826.

*Uvigerina* d'Orbigny (type, *U. pygmæa* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 268.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 573.

*Description.*—Test elongate, spiral, consisting of numerous chambers, usually arranged triserially, occasionally in later growth with fewer than three chambers in each volution; wall calcareous, perforate, hyaline, smooth or ornamented with spines or costæ or modifications of them; aperture with usually a tubular neck at the end of which is a phialine lip.

The genus *Uvigerina* is one of the most clearly distinguished of any of the genera of the Foraminifera. Its triserial arrangement of chambers with a tubular aperture and phialine lip will at once serve to distinguish it. In some of the species in the last-formed chambers there is a tendency to reduce the number of chambers in a volution to two, or even to become almost uniserial as in *Uvigerina interrupta* H. B. Brady. The surface ornamentation presents a considerable range from smooth and unornamented as in *U. canariensis* d'Orbigny, through the finely striate forms to ones with heavy costæ, and these may be broken into spines or the whole test may be spinose, as in *U. asperula* Czjzek and *U. interrupta* H. B. Brady. One of the most interesting forms of ornamentation in the genus is the secondary development of spines in *U. aculeata* d'Orbigny, developed in the later chambers first, but progressively extending backward and finally in some cases covering the entire test.

The genus *Uvigerina* is known from the Eocene through the later formations of the Tertiary to the present. Some of the species seem to have a limited distribution, both geographically and bathymetrically, but others, as *U. pygmæa* d'Orbigny, have a much wider range geographically and are found to considerable depths.

### UVIGERINA CANARIENSIS d'Orbigny.

Plate 42, fig. 6.

"Testæ pineiforme sminusculæ" SOLDANI, Testaceographia, vol. 2, 1798, p. 18, pl. 4, figs. E, F, G, H.

*Uvigerina nodosa*, var. B D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 269, No. 3.

*Uvigerina canariensis* D'ORBIGNY, Foram. Canaries, 1839, p. 138, pl. 1, figs. 25-27.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 573, pl. 74, figs. 1-3.—WOODWARD and THOMAS, 13th Ann. Rep. Geol. Nat. Hist. Survey Minnesota for 1884 (1885), p. 171, pl. 4, fig. 37; Geol. Nat. Hist. Survey rial from the stomachs of holothurians dredged at *Albatross* station D3603 at 1,771 fathoms and from both the eastern and western sides of the North Pacific in depths from 1,597 to 2,112 fathoms. From the region of the Hawaiian Islands Bagg records it from three *Albatross* stations, D4000, D4025, and H4571 in from 104 to 384 fathoms. The least depth at which any of the material of this species which I have examined was dredged was at *Tuscarora* station 11 in 437 fathoms, about midway between the Hawaiian Islands and the California coast. Brady did not record the species from the North Pacific.

From the material at hand and a study of the published figures referred to this species it is evident that there is a considerable difference in the material referred here. Some of the figured specimens are fusiform, decidedly tapering at either end and with a long, drawn out tubular neck, others as in the figured specimen are much the largest near the apertural end. All are uniform in having the surface of the adult chambers smooth, but the early chambers are either smooth as in the type figure, or slightly costate (*U. urnula* d'Orbigny) or slightly spinose as in the figured specimen. A larger series should throw some light on the actual distribution of the various forms now included under this specific name.

### UVIGERINA CANARIENSIS d'Orbigny, subspecies STRIATA Bagg.

*Uvigerina canariensis* D'ORBIGNY, subspecies *striata* BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 151, pl. 5, fig. 2.

*Description.*—"* * * A form which has definite striations extending in groups clear and well defined, though not closely set down, and over the last chamber as well as over the earlier segments as in *Uvigerina pygmæa*. The inflation of the segments is marked and the septa are depressed."

*Distribution.*—Bagg described this subspecies from material dredged off the Hawaiian Islands at *Albatross* station H4566 in 572 fathoms. I have examined the type-specimen, but in the absence of sufficient material am inclined to leave it here until more may be available. The description is copied from the original. A single specimen very similar to that figured by Bagg was found in globigerina ooze at *Nero* station 172 in 2,086 fathoms near the Midway Islands.

### UVIGERINA SELSEYENSIS Heron-Allen and Earland.

Plate 42, fig. 5.

*Uvigerina selseyensis* HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1909, p. 437, pl. 18, figs. 1-3.

*Description.*—Test subovate, broadest toward the apertural end, chambers numerous, early ones rotund, triserially arranged, later ones more or less trihedral, more loosely arranged; the outer lower margins somewhat angular and projecting, wall smooth, aperture with a very short broad neck with a narrow phialine lip.

Length about 0.35 mm.

*Distribution*.—This species, described as a European fossil, seems to occur in the North Pacific, specimens from *Albatross* station H2923 in 392 fathoms being very similar to *U. selseyensis*. The figure does not show the angular character of the periphery of the chambers, but this occurs and makes the resemblance much more striking, and the comparison made by the authors that the species resembles both *U. angulosa* and *U. porrecta* is well sustained.

### UVIGERINA PROBOSCIDEA Schwager.

Plate 42, fig. 2.

*Uvigerina proboscidea* SCHWAGER, *Novara* Exped., Geol. Theil, 2, 1866, p. 250, pl. 7, fig. 96.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 312, pl. 9, fig. 53.

*Description*.—Test ovate, tapering somewhat at either end, chambers inflated, but closely set with sutures nearly flush, surface slightly hispid with very fine aculei, aperture with a tapering tubular neck with the greatest diameter near the base and a slightly phialine lip.

Length about 0.5 mm.

*Distribution*.—Not previously recorded from the North Pacific. Described from the Pliocene of Kar Nicobar and recorded by Egger from *Gazelle* station 90 off Western Australia. Specimens which seem to be this species were found at *Nero* station 1464 in 891 fathoms off Guam.

eem to fit excellently the figure and description of *U. striata* given y d'Orbigny. The finely costate tapering test and the characters f the apertural portion are very different from the more common naterial usually referred by authors to *U. pygmæa*.

### UVIGERINA TENUISTRIATA Reuss.

Plate 42, fig. 4.

*Uvigerina tenuistriata* Reuss, Sitz. kais. Akad. Wiss. Wien, vol. 52, 1870, p. 485.—von Schlicht, Foram. Pietzpuhl, 1870, pl. 22, figs. 34–36.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 574, pl. 74, figs. 4–7.—Egger, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 18, 1893, p. 315, pl. 9, figs. 44, 52.

*Description.*—Test elongate, subcylindrical, tapering at the apical end, composed of numerous rounded chambers with distinct sutures; wall with numerous fine raised longitudinal costæ, except the distal portion of the last-formed chamber, or in full-grown specimens more than the last chamber, with roughened or even nearly smooth walls; aperture with a short comparatively thick tubular neck with usually a distinct phialine lip.

Length about 1 mm.

*Distribution.*—Recorded by Brady in the North Pacific in 95 fathoms off the Philippines. I have not seen material definitely referable to this species from the North Pacific. Bagg's material which I have xamined seems to belong to *U. striata*, although recorded by him under he name *tenuistriata*.

### UVIGERINA STRIATULA, new species.

Plate 44, fig. 3.

*Description.*—Test elongate, fusiform, tapering gradually from the iddle toward either end; composed of numerous inflated chambers, hose last formed considerably drawn out, wall usually thin and ranslucent, finely and distinctly striated; aperture with a tubular eck and phialine lip.

Length about 0.5 to 0.7 mm.

*Distribution.*—Type-specimen, Cat. No. 8551, U.S.N.M., from *Nero* tation 1310 in 518 fathoms, globigerina ooze, near the Bonin Islands. also occurred from the same region at *Nero* Station 1306 in 1,208 thoms, also in globigerina ooze.

In its extreme modification this species has a general resemblance *U. interrupta* H. B. Brady, but most of the specimens examined are less drawn out than is usual in that species.

### UVIGERINA PYGMÆA d'Orbigny.

Plate 42, fig. 1; plate 44, fig. 5.

"Polymorpha Pineiformia" Soldani, Testaceographia, vol. 1, pt. 2, 1791, pl. 130, figs. *ss*, *tt*.

*Uvigerina pigmea* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 269, pl. 12, figs. 8, 9; Modelès, 1826, No. 67.

*Uvigerina pygmæa* d'Orbigny, For. Foss. Bass. Test. Vienne, 1846, p. 190, pl. 11, figs. 25, 26.—Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 297, pl. 11, figs. 41–43.—Williamson, Rec. Brit. Foram., 1858, p. 66, pl. 5, figs. 138, 139.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 29, pl. 2, fig. 54.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 363, pl. 17, figs. 65*a*, *b*; pl. 13, fig. 54.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 171, pl. 11, fig. 109.—Schwager, Boll. R. Com. Geol. Ital., vol. 8, 1877, p. 25, pl., fig. 34.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 59, pl. 4, figs. 68–70.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 575, pl. 74, figs. 11–14.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 224, pl. 45, figs. 1, 2.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Akad. Wiss., München, Cl. ii, vol. 18, 1893, p. 314, pl. 9, fig. 42.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 51, pl. 9, figs. 496–501.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.—Goës, Bull. Mus. Comp. Zoöl., vol. 26, 1896, p. 50.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 2.—Millett, Journ. Roy. Micr. Soc., 1903, p. 269.—Chapman, Trans. New Zealand Inst., vol. 38, 1905 (1906), p. 99.—Sidebottom, Mem. Manchester Lit. and Philos. Soc., vol. 54, 1910, No. 16, p. 23.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 414.

*Uvigerina bifurcata* d'Orbigny, Foram. Voyage Amér. Mérid., 1839, p. 53, pl. 7, fig. 17.

*Uvigerina semiornata* d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 189, pl. 11, figs. 23, 24.

the entrance of the Gulf of California, the other southwest of Panama. In the material I have examined it has occurred frequently in the *Albatross*, *Nero*, and *Tuscarora* dredgings.

D'Orbigny's original figures of this species show a fusiform tapering test, in which the last-formed chambers lack the characteristic costæ and in which the tubular neck is long. Later in his Vienna Basin monograph he uses the same name for a test of different form, still fusiform but with a much shorter and stouter neck. In recent material, however, in almost all cases the later-formed chambers are broad and the test is much broader toward the apical end. The figures given by Brady, Parker, and Jones[1] of specimens from the Abrolhos Bank and by Flint[2] show the typical form so abundant in the cooler waters of recent seas.

### UVIGERINA SCHWAGERI H. B. Brady.

Plate 37, figs. 3, 4.

*Uvigerina schwageri* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 575, pl. 74, figs. 8-10.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.

*Description.*—Test elongate, subovate, tapering to a blunt point at the aboral end; segments numerous, only slightly inflated externally; surface ornamented by a few ill-defined, partial costæ; color pure white.

Length 1.6 mm.

*Distribution.*—Brady records this species from 95 fathoms off the Philippines in the North Pacific as well as from off the Fiji Islands and Torres Strait. Chapman records it from the Arabian Sea. Outside of the Philippine region I have failed to find this species in the North Pacific.

The figures and description are from Brady.

### UVIGERINA BRUNNENSIS Karrer.

Plate 43, fig. 2.

*Uvigerina brunnensis* Karrer, Abh. k. geol. Reichs., vol. 9, 1877, p. 385, pl. 16*b*, fig. 49.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 577, pl. 75, figs. 4, 5.—Egger, Abh. kön. bay. Akad. Wiss. München, 1893, p. 312, pl. 9, figs. 60, 61.—Chapman, Proc. Zool. Soc. London, 1895, p. 36.

*Description.*—Test elongate, composed of numerous inflated chambers, wall with longitudinal costæ for the most part breaking up into rows of spinose projections longitudinally placed; aperture with a short stout neck with a broad phialine lip.

Length about 0.75 mm.

*Distribution.*—This species has not hitherto been recorded from the North Pacific. Brady's stations were off Christmas Harbor, Kerguelen Island, 120 fathoms, and off the western shore of Patagonia, 245 fathoms. Egger also recorded it at two stations off Kerguelen at similar depths. Chapman records it from the Arabian Sea. I have had the species from numerous stations, only one, *Albatross* station H2764, 122 fathoms near the Hawaiian Islands, being less than a thousand fathoms. It has occurred at numerous *Nero* stations mostly between Guam and Yokohama in 1,415 to 2,135 fathoms.

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[1] Trans. Zool. Soc. London, vol. 12, 1888, pl. 45, figs. 1, 2.

[2] Ann. Rep. U. S. Nat. Mus., 1897 (1899), pl. 68, fig. 2.

Although the recent material does not agree very closely with Karrer's original description it may be left under that name.

### UVIGERINA ANGULOSA Williamson.

Plate 44, fig. 4.

*Uvigerina angulosa* Williamson, Rec. Foram. Great Britain, 1858, p. 67, pl. 5, fig. 140.—Seguenza, Atti Accad. Lincei., ser. 3, vol. 6, 1879, pp. 226, 307.—Bütschli, in Bronn, Klassen und Ordnungen Thier-Reichs, vol. 1, 1880, p. 200, pl. 7, fig. 31.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 576, pl. 74, figs. 15–18.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 347.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 314, pl. 9, figs. 40, 46, 47.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 51, pl. 9, figs. 502–509.—Jones, Pal. Soc., 1895, p. 277, pl. 7, fig. 26.—Chapman, Proc. Zool. Soc., London, 1895, p. 35.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 3.—Liebus, Neues Jahrb. für Min., vol. 1, 1901, p. 120, pl. 5, fig. 3.—Millett, Journ. Roy. Micr. Soc., 1903, p. 269.—Chapman, Journ. Quekett Micr. Club., ser. 2, vol. 10, 1907, p. 132, pl. 10, fig. 5.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 52, pt. 3, No. 13, 1908, p. 1, pl. 1, fig. 4.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, new series, pt. 2, 1910, p. 281.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, pt. 3, No. 16, 1910, p. 23.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1910, p. 414.

*Uvigerina pygmaea*, var. *angulosa* Parker and Jones, Philos. Trans., vol. 155,

### UVIGERINA ANGULOSA Williamson, var. SPINIPES H. B. Brady.

Plate 43, fig. 3.

*Uvigerina spinipes* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 64.
*Uvigerina angulosa* Williamson, var. *spinipes* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 577, pl. 74, figs. 19, 20.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 315, pl. 9, fig. 59.—Chapman, Proc. Zool. Soc. London, 1895, p. 200.

*Description.*—Test elongate, tapering toward either end, chambers more or less triangular in cross section, early chambers with longitudinal costæ often prolonged into spinose projections at the apical end; later chambers with smooth walls and more loosely arranged; aperture with a tubular neck gradually merging into the outline of the chamber at the proximal end and with a definite phialine lip at the outer end.

Length about 0.75 mm.

*Distribution.*—This variety has not been recorded from the North Pacific. Brady recorded it from off Tristan d'Acunha, Egger from two stations off New Amsterdam and West Australia, and Chapman from the Arabian Sea.

The only North Pacific material I have seen is from *Nero* station 1306, in 1,208 fathoms between Yokohama and Guam. The figured specimen is from this station.

Brady described this as a distinct species and it certainly has but little in common with *U. angulosa* Williamson. With the exception of one of the stations recorded by Chapman and one by Egger, it has not occurred in company with *U. angulosa*, but as these are two from only five stations the percentage is rather large. The spinose condition of the early chambers is also different from what is usually seen in *U. angulosa.*

### UVIGERINA PORRECTA H. B. Brady.

Plate 44, fig. 2.

*Uvigerina porrecta* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 60, pl. 8, figs. 15, 16; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 577, pl. 74, figs. 21-23.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 315, pl. 9, figs. 51, 63.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1910, p. 414.

*Description.*—Test much elongated, early chambers in a close spiral, later ones drawn out and considerably separated from one another; chambers, especially the later ones, concave below, the peripheral edge angular and projecting; upper surface of the chambers convex and ornamented by coarse longitudinal costæ which project at the peripheral edge, making it serrate; aperture with an elongated tubular neck, the lip not well developed.

Length about 0.5 mm.

*Distribution.*—From the known records this species seems to be confined to the region of coral reefs, although it may occur at considerable depths, as shown by Chapman, who records it at 2,400 fathoms off Funafuti. Such records as have already been noted in regard to other coral reef species in this paper may be due to the carrying out of such species into deep water through the action of currents. Brady records this species from north of New Guinea in 1,850 fathoms as the only North Pacific station. I have not seen it from the region of the coral reefs of the Hawaiian Islands nor does Bagg record it from this region. I have found it, however, in material from several *Nero* stations near Guam in 859 to 1,503 fathoms. This material is typical.

There is a considerable variation in the costæ, which in some cases, as shown in figure 2, are only developed on the periphery of the chambers.

### UVIGERINA ACULEATA d'Orbigny.

Plate 43, fig. 4.

*Urigerina aculeata* D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 191, pl. 11, figs. 27, 28.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 578, pl. 75, figs. 1, 2.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 311, pl. 9, figs. 48, 49.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 35.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 50.—FORNASINI, Boll. Soc. Geol. Ital., vol. 25, 1907, p. 348, pl. 4, fig. 1.—CHAPMAN, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 414.

*Description.*—Test elongate, tapering; chambers numerous, inflated, sutures distinct, even under the ornamentation which in the

### UVIGERINA ASPERULA Czjzek.

Plate 43, fig. 1.

*Uvigerina asperula* Czjzek, Haidinger's Nat. Abh., 2, 1848, p. 146, pl. 13, figs. 14, 15.—Reuss, Sitz. kais. Akad. Wiss., Wien, vol. 55, Abth. 1, 1867, p. 93, pl. 4, figs. 6*a*, *b*, 7, 8, 9.—Terrigi, Atti Accad. Port. Nuovi Lincei, vol. 35, 1883, p. 185, pl. 2, fig. 26.—H. B. Brady, Rep. Voy. *Challenger*. Zoology, vol. 9, 1884, p. 578, pl. 75, figs. 6–8.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 755, pl. 16, fig. 7.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 225, pl. 45, figs. 4, 5.—Terrigi, Mem. Com. Geol. Italia, vol. 4, 1891, p. 100, pl. 3, fig. 25.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. ii, vol. 18, 1893, p. 312, pl. 9, fig. 41.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1903, p. 267.—Chapman, Trans. New Zealand Inst., vol. 38, 1906, p. 99; Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 150.

*Description.*—Test elongate-ovate, chambers somewhat inflated, sutures distinct but not deep; surface ornamented by a hispid or spinose exterior of much variableness in different specimens, the fine spines either in indefinite longitudinal rows or scattered without a definite arrangement; initial end bluntly rounded or with a distinct stout spine, aperture with a definite tubular neck with a well developed phialine lip.

Length 0.6 to 0.8 mm.

*Distribution.*—From the material examined this seems to be one of the most common species of the genus, having been dredged at many stations in various parts of the North Pacific, from 323 to 1,758 fathoms. It was recorded from between 20 and 40 stations well scattered over the area. The bottom temperature where recorded is in almost all cases between 35° and 36° F.

Brady records this species from three stations in the North Pacific in 345 to 2,300 fathoms, and Bagg records it from 13 *Albatross* stations off the Hawaiian Islands in 275 to 1,544 fathoms.

There is certainly a very considerable difference in the shape and ornamentation of the various forms assigned to this species. Even in the material examined it appears that various modifications can be segregated, and with sufficient material from other areas it would not be difficult to establish definite groups which have in general a hispid ornamentation.

The specimen figured is one of medium coarseness as far as the ornamentation is concerned.

### UVIGERINA AMPULLACEA H. B. Brady.

Plate 42, fig. 3.

*Uvigerina asperula* Czjzek, var. *ampullacea* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 579, pl. 75, figs. 10, 11.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1903, p. 267.—Bagg, Proc, U. S. Nat. Mus., vol. 34, 1908, p. 150.—Chapman, Journ. Linn. Soc., Zoology' vol. 30, 1910, p. 415.

*Uvigerina ampullacea* Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 313, pl. 9, fig. 37.

*Uvigerina auberiana* Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 52, pl. 9, figs. 494, 495.

*Description.*—Test composed in the early portion of a more or less compact spiral of chambers followed by two or more chambers uniserially arranged; surface finely hispid, with pointed aculei; aperture with an elongate neck and narrow rimmed phialine neck.

Length about 1 mm.

*Distribution.*—From the material examined this species is much less common in the North Pacific than *U. asperula*. It has occurred at numerous stations, mainly in the western Pacific and about the Hawaiian Islands. The shallowest station is *Nero* station, 2034, in 175 fathoms, near the Hawaiian Islands, and the deepest is *Nero* station 187, in 2,473 fathoms. Most of the stations had depths of less than 1,500 fathoms. The only stations from which the bottom temperatures are recorded are 35° and 38° F. Bagg records this species from several *Albatross* stations off the Hawaiian Islands in 384 to 1,342 fathoms.

*Distribution.*—Bagg records this species from several *Albatross* ations in the vicinity of the Hawaiian Islands, in 384 to 1,307 thoms. I have not found North Pacific material which seemed to e definite enough to assign to this species.

D'Orbigny's figure shows a coarsely spinose test with a shape mewhat different from that given by Brady and which is reprouced here.

### UVIGERINA AUBERIANA d'Orbigny, forma LÆVIS Goës.

*Uvigerina auberiana* Goës (part), Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 60, pl. 4, figs. 71–74.

*Uvigerina auberiana* D'ORBIGNY, forma *lævis* GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 51.

*Description.*—"Our form comes very near to *U. farinosa* Hantken,[1] nd is in all respects but for its smooth surface of similar build as he type, the strong relationship of which it shows, even by its arliest segments being provided with a few short spines or warts."

Length about 0.50 to 1 mm.

*Distribution.*—Given by Goës as found in the Eastern Pacific in 600 to 1,201 fathoms.

The above description is copied from Goës. No figure was given.

### UVIGERINA INTERRUPTA H. B. Brady.

Plate 44, fig. 1.

*Uvigerina interrupta* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 60, pl. 8, figs. 17, 18; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 580, pl. 75, figs. 12–14.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 313, pl. 9, fig. 58.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 34.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 268.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 151.—CHAPMAN, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.

*Description.*—Test slender, elongate, loosely spiral, chambers inlated, earlier ones in a more or less compact spire, later ones in an nterrupted irregularly spiral series; surface with fine spines, giving hispid character to the whole test; aperture with an elongated ubular neck and a phialine lip at its termination.

Length about 0.5 mm.

*Distribution.*—In the North Pacific the only records for this species re those given by Bagg, *Albatross* stations H4430, H4440, and 4508, in 1,544, 1,259, and 495 fathoms, respectively. In the aterial I have examined it has occurred most commonly off Guam nd in the region between Guam and southern Japan, about the awaiian Islands, and off the Galapagos. The last were much moother than the usual form. In depth the stations range from

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[1] For. Clavul. Szábol Sch., 1875, Separ., pl. 7, fig. 6.

437 to 1,505 fathoms. In temperature there is data but for three stations, 437 fathoms off Japan, 39.8° F.; 1,505 fathoms also off Japan, 35.7° F.; and 1,379 fathoms off the Galapagos, 36.4° F. In general, this species seems to have a tropical distribution running up to southern Japan.

### Genus SIPHOGENERINA Schlumberger, 1883.

*Sagrina* Parker and Jones (not *Sagrina* d'Orbigny), Philos. Trans., vol. 155, 1865, p. 363.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 580.

*Dimorphina* Schwager (not *Dimorphina* d'Orbigny), *Novara* Exped., Geol. Theil., vol. 2, 1866, p. 251.

*Siphogenerina* Schlumberger [type, *S. raphanus* (Parker and Jones), *Uvigerina* (*Sagrina*) *raphanus* Parker and Jones], Feuille des Jeunes Naturalistes, ann. 13, 1883, p. 117.

*Description.*—Test elongate, composed at least in the microspheric form of a series of chambers arranged tri- or biserially, followed by a later uniserial development; walls hyaline and perforate, aperture in the uniserial portion central and terminal, usually with an elongated neck and flaring lip; interior of the chamber with a tubular connection running from the base of the apertural neck to the lip of the aperture below; wall smooth or ornamented by costæ, pits, etc.

This genus is evidently closely related to *Uvigerina*, but seems to be distinct in its uniserial development, which in *Siphogenerina* becomes the major portion. In the megalospheric form the uniserial condition is taken on much earlier than in the microspheric form.

Both genera, *Sagrina* and *Dimorphina*, as used by d'Orbigny, undoubtedly belong to the Textulariidæ, and are not available for use of the uniserial portion well rounded, shorter than broad, sutures only slightly constricted; aperture large, terminal, with a very short tubular neck and broad flaring lip; wall smooth.

Length about 1 mm.

*Distribution.*—The only published North Pacific records are those given by Bagg. These are seven *Albatross* stations in the vicinity of the Hawaiian Islands, 104 to 1,544 fathoms. I have found the species fairly common in the region from near the Hawaiian Islands, *Albatross* H2922 in 268 fathoms, *Nero* 2071 in 271 fathoms, and off the coast of Japan, D4968 in 253 fathoms. It has occurred also in the *Nero* material from numerous stations on the line of soundings between Yokohama and Guam in 1,208 to 1,660 fathoms. This species has been found at three *Tuscarora* stations, 57 and 58, in 814 and 1,331 fathoms near the Bonin Islands and at station 15 in 1,874 fathoms south of the Midway Islands. The bottom temperatures where recorded are 44.8° and 45.7° F. off Japan and the Hawaiian Islands, but at the deeper *Nero* soundings go down to 35° F.

### SIPHOGENERINA BIFRONS (H. B. Brady).

Plate 45, figs. 1, 2, 5–7.

*Sagrina bifrons* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 64; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 582, pl. 75, figs. 18–20.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 134, pl. 15, figs. 25, 26.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 270.—CHAPMAN, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.

*Siphogenerina* (*Sagrina*) *bifrons* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 317, pl. 9, figs. 25, 26, 29.

*Description.*—Test elongate, compressed, straight or very slightly curved, in end view elliptical, median portions of the broad faces somewhat concave, megalospheric form with the apical end broadly rounded and of about the same diameter as the rest of the test, microspheric form with the apical end much more attenuate, growing rapidly broader, then contracted where the uniserial portion begins; sutures hardly depressed, distinct, often of clear material, appearing darker than the rest of the test; aperture rounded, without a distinct neck but with a slight rounded lip; microspheric form usually the larger.

Length 0.75 to 1 mm.

*Distribution.*—Brady described this species from material dredged in 345 fathoms on the *Hyalonema*-ground off southeastern Japan. This is the only locality noted in the *Challenger* Report. It has been recorded by Egger off west Australia, by Millett from the Malay Archipelago, and by Chapman from about Funafuti. Apparently the species belongs to a warm-water fauna reaching its northern limit off Japan. Egger's material was from 560 fathoms, Millett's material from shallow water, while Chapman's specimens were from 2,400 fathoms, but the occurrence in deep water off oceanic islands has been several times referred to.

In the material which I have examined the species has occurred at several stations off southeastern Japan in the region from which Brady's types came. These stations have depths of from 191 to 500 fathoms. It was also found to be frequent off the Philippines, occurring at *Nero* station 849 in 737 fathoms.

As is usual in other species the microspheric form occurs less frequently than the megalospheric and the latter does not attain as large dimensions. The two may be distinguished at a glance as the megalospheric form, which is represented in all of Brady's figures, is bluntly rounded, the early portion being of about the same diameter as the later developed, uniserial portion. In the microspheric form the early portion is more acute and tapering, the test above being contracted at the beginning of the uniserial portion.

Occasionally specimens of this species show traces of delicate striations.

One point of particular significance is the fact shown in fig. 5, where it may be seen that in the microspheric form there is a tendency toward a spiral development in the earliest chambers. This shows the relationship of this genus to close coiled genera such as *Cristellaria* and its probable development from a close coiled form.

The relation of the interior tubular structure to the walls of the test is diagrammatically shown in fig. 7.

In four cases the bottom temperature is given for the stations at which this species has occurred. They are 39.1°, 44.1°, 45.7°, and comparatively large pitted depressions or perforations: aperture circular with a very short neck and flaring lip.

Length 0.5 to 0.8 mm.

*Distribution.*—Bagg records this species from three *Albatross* stations in the vicinity of the Hawaiian Islands, in 572 to 1,259 fathoms. In the same region it occurs at *Albatross* station H3007 in 323 fathoms. In the western Pacific it has occurred off the coast of Japan, *Albatross* station D4957 in 437 fathoms. It also occurred at *Nero* stations 1306 and 1311 in 1,208 and 1,503 fathoms and at two *Tuscarora* stations 47 and 58 in 1,499 and 814 fathoms. These last four stations are not far from the Bonin Islands. At D4957 the bottom temperature was 39.8°, but it is not recorded from the other stations.

This species is more widely distributed than others of the genus, both in depth and area. It is characteristic in its appearance and can easily be distinguished.

Goës [1] refers to this species a form which is evidently a *Clavulina*, as his figures and description show. Later he figured a specimen in his work on the Scandinavian Foraminifera [2] which very clearly belongs to this species.

The interior has the characteristic tubular structure as shown in fig. 4, *c*.

### SIPHOGENERINA STRIATA (Schwager).

Plate 47, figs. 4, 5.

*Dimorphina striata* SCHWAGER, *Novara* Exped., Geol. Theil., vol. 2, 1866, p. 251, pl. 7, fig. 99.

*Sagraina striata* SCHWAGER, Bull. Comm. geol. Ital., vol. 8, 1877, p. 25, pl., fig. 35.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1894, p. 584, pl. 75, figs. 25, 26.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 272.

*Siphogenerina* (*Sagrina*) *striata* EGGER [?], Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 316, pl. 9, figs. 32, 34, 35, 64, 65.

*Description.*—Test elongate, cylindrical, chambers of the uniserial portion broader than long, sutures not deep but conspicuous, wall ornamented by longitudinal costæ, not close together and not high; aperture circular with no neck but a prominent rounded lip.

Length 0.75 to 1 mm.

*Distribution.*—Brady records this species at one North Pacific station off the Philippines in 95 fathoms. I have found specimens from the vicinity of the Hawaiian Islands, *Nero* station 2035, in 114 fathoms, *Nero* Station 1466, off Guam, 234 fathoms, and a specimen which can be referred here from *Nero* station 1321, southeast of the Bonin Islands in 1,618 fathoms.

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[1] Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 62, pl. 4, figs. 77–81.

[2] Idem, vol. 25, No. 9, 1894, pl. 9, figs. 510, 511.

From the original figure given by Schwager this recent form would seem to be distinct in the large aperture which is without a neck, the chambers low and broad, while the figure given by Schwager shows a typical *Uvigerina* aperture, the neck long and slender and the chambers as long as broad and much more inflated. I am inclined to think that our recent species figured here is distinct, but more material is necessary to establish this view.

### SIPHOGENERINA RAPHANUS (Parker and Jones).

Plate 46, figs. 1–5.

*Uvigerina* (*Sagrina*) *raphanus* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 364, pl. 18, figs. 16, 17.

*Sagrina raphanus* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 585, pl. 75, figs. 21–24.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 272.—CHAPMAN, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.

*Siphogenerina* (*Sagrina*) *raphanus* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 317, pl. 9, fig. 36.

*Siphogenerina costata* SCHLUMBERGER, Feuille des Jeunes Naturalistes, ann. 13, 1883, p. 118, fig. 13.

*Description.*—Test elongate, cylindrical, or tapering, chambers of the uniserial portion broader than long; surface marked by several rather widely separated, well-developed costæ, each extending nearly the length of the test and not affected by the sutures; aperture typically with a short tubular neck and well-developed flaring lip.

Length 0.5 to 1 mm.

*Distribution.*—Brady records the occurrence of this species from off the Philippines in 95 fathoms, off the coral reefs of Honolulu, Hawaiian Islands, in 40 fathoms and in the volume of the *Challenger* "Report

***Distribution.***—This species has occurred at numerous stations in the region between Yokohama and Guam, depths ranging from 859 fathoms to 1,660 fathoms. Type, Cat. No. 8552, U.S.N.M., from *Nero* station 1472 in 1,000 fathoms. No bottom temperatures are recorded for any of the stations at which this species has occurred, but where they are given from adjacent stations they are below 40° F.

The fine striate surface and the form of the aperture will serve to distinguish this species.

### SIPHOGENERINA IRREGULARIS (Bagg).

Plate 47, figs. 6, 7.

*Sagraina irregularis* BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 152, pl. 5, figs. 8-10.

*Description.*—Test elongate, subcylindrical; chambers somewhat irregular, but becoming uniserial in the later developed portion; variable as regards height of individual chambers; surface ornamented with very fine costæ; wall thin and translucent, apertural end of the chamber depressed; aperture slightly excentric, with a long tubular neck and a slightly flaring lip.

Length 0.75 to 1.50 mm.

***Distribution.***—Bagg described this species from *Albatross* material dredged near the Hawaiian Islands, D4025 in 275 to 368 fathoms and H4571 in 384 fathoms. I have found the species at four stations in this same region, *Albatross* H2922, H2923, and H2986 in 268, 392, and 271 fathoms. It also occurred at *Nero* station 2071, in 271 fathoms. But one station, H2922, has the bottom temperature recorded, this being 44.8° F. However, the adjacent station to H2986 at nearly the same depth has a recorded temperature of 48.1° F. Evidently this species is a somewhat local one, but is to be watched for elsewhere under similar conditions. This belongs to *Siphogenerina*, as is shown by the figure of the interior, fig. 7.

There is a specimen from *Nero* station 166 in 1,850 fathoms northeast of Midway Island, which has many of the characteristics of this species, but the costæ are much coarser. It may be a deep-water form of this species. Bagg speaks of this species as resembling *S. striata* (Schwager), but it much more closely resembles the figure given by Schwager[1] and named by him *Uvigerina nitidula*.

### SIPHOGENERINA (?) ANNULATA (H. B. Brady).

Plate 37, figs. 8, 9.

***Sagrina*** (?) ***annulata*** H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 586, pl. 76, figs. 20, 21.

***Description.***—"Test subcylindrical; oral end rounded, aboral extremity obtusely angular or rounded; composed of few (two to four), elongate, somewhat inflated segments, united end to end. Surface marked by closely set, slightly depressed, transverse lines. Aperture a simple terminal rounded orifice."

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[1] *Novara* Exped., Geol. Theil, vol 2, 1867, pl. 7, fig 93.

"Length $\frac{1}{35}$ inch (0.75 mm.)."

*Distribution.*—Described by Brady from material dredged from Honolulu coral reefs in 40 fathoms.

The description and figures are from Brady. He questions whether or not the species may be a *Sagrina* and until further material may be found its affinities can not clearly be determined.

### Subfamily 5. RAMULININÆ.

Test composed of branching tubular masses with rounded chamber-like portions at irregular intervals.

### Genus RAMULINA Rupert-Jones, 1875.

*Ramulina* Rupert-Jones (type, *R. lævis* Rupert-Jones) in Wright, Rep. Proc. Belfast Nat. Field Club, 1873–74, App. III, 1875, p. 88 [90].

*Description.*—Test free, branching, consisting of more or less round chambers connected by long stoloniferous tubes; wall hyaline.

This genus includes rather ill-defined forms, suggesting the so-called "wild growth" seen in the final chambers of certain species of *Polymorphina*. Just what its relations are to the rest of the Lagenidæ is not really determined. It seems to occur in the Cretaceous and there are one or two recent species.

#### RAMULINA GLOBULIFERA H. B. Brady.

Plate 39, fig. 1.

## EXPLANATION OF PLATES.

### PLATE 1.

ig. 1. *Lagena lateralis.* × 125. *a*, front view by transmitted light; *b*, apertural view; *c*, front view; *d*, side view.
2. *Lagena collaris.* × 125. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
3. *Lagena lævis.* × 65. *a*, front view; *b*, side view; *c*, apertural view.
4. *Lagena gracillima.* × 65. *a*, front view; *b*, apertural view.
5. *Lagena elongata.* × 35. *a*, front view; *b*, apertural view.

### PLATE 2.

ig. 1. *Lagena lævigata.* × 65. *a*, front view; *b*, apertural view; *c*, front view by transmitted light.
2. *Lagena ovum.* × 125. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
3. *Lagena clavata.* × 125. *a*, front view; *b*, apertural view.

### PLATE 3.

igs. 1-3. *Lagena sacculus.* 1. Form with slight development of keel × 65. *a*, apertural view; *b*, front view; *c*, same by transmitted light.
2. Form with medium keel × 65. *a*, apertural view; *b*, front view; *c*, same by transmitted light.
3. Form with broad keel × 125. *a*, apertural view; *b*, front view; *c*, same by transmitted light.

### PLATE 4.

ig. 1. *Lagena felsinea.* × 75. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
2. *Lagena globosa.* *a*, front view, × 75; *b*, apertural view, × 75; *c*, optical section, × 40.
3. *Lagena ampulla-distoma*, var. *cribrostomoides.* *a*, front view, × 90; *b*, basal view, × 90; *c*, view of aperture, × 300.
4. *Lagena hispida.* × 150. *a*, front view; *b*, apertural view.
5. *Lagena hispida.* × 90. *a*, front view; *b*, apertural view.

### PLATE 5.

ig. 1. *Lagena hispida.* × 90.
2. *Lagena hispidula.* × 90. *a*, front view; *b*, apertural view.
3. *Lagena hispidula.* × 90.
4. *Lagena punctulata.* *a*, front view, × 90; *b*, apertural view, × 90; *c*, portion of surface, × 300.
5. *Lagena hystrix.* *a*, front view, × 90; *b*, apertural view, × 90; *c*, portion of surface, × 300.

### PLATE 6.

ig. 1. *Lagena squamosa.* × 125. *a*, front view; *b*, apertural view.
2. *Lagena hexagona.* × 65. *a*, front view, *b*, apertural view in outline; *c*, detail of aperture.
3. *Lagena hexagona.* × 125. *a*, front view; *b*, apertural view in outline.
4. *Lagena hexagona*, var. *scalariformis.* × 125.

## Plate 7.

Fig. 1. *Lagena catenulata*. × 150. *a*, front view; *b*, apertural view.
2. *Lagena catenulata*. × 75.
3. *Lagena foveolata*. × 75. *a*, front view; *b*, apertural view.
4. *Lagena striata*. × 75.
5. *Lagena striata*. × 75.
6. *Lagena striata*, var. *haidingeri*. × 75. *a*, front view; *b*, apertural view.
7. *Lagena striata*, var. *strumosa*. × 90.
8. *Lagena striata*, var. *strumosa*. × 90.
9. *Lagena striata*, var. *strumosa*, neck. × 150.
10. *Lagena striata*, var. *strumosa*, neck. × 150.

## Plate 8.

Fig. 1. *Lagena striata*, var. *substriata*, elongate form. × 150. *a*, front view; *b*, apertural view.
2. *Lagena striata*, var. *substriata*. × 150.
3. *Lagena striata*, var. *substriata*. × 180. Apertural portion of unbroken specimen showing spiral ornamentation of neck.
4. *Lagena mucronulata*. × 75.
5. *Lagena gracilis*. × 75. *a*, front view; *b*, apertural view.
6. *Lagana gracilis*, neck. × 150.
7. *Lagena gracilis*, var. × 150.
8. *Lagena inferocostata*. × 75. *a*, front view; *b*, apertural view; *c*, basal view.
9. *Lagena acuticosta*. × 75. *a*, front view; *b*, apertural view.
10. *Lagena acuticosta*. × 75.

## Plate 9.

Fig. 1. *Lagena acuticosta*, var. *paucicostata*. × 75. *a*, front view; *b*, apertural view.
2. *Lagena sulcata*. × 75.
3. *Lagena sulcata*, var. *apiculata*. × 75. *a*, front view; *b*, apertural view.

### PLATE 12.

ig. 1. *Lagena costata*, oval form. × 90. *a*, front view; b, apertural view.
2. *Lagena costata*, var. *amphora*. × 90. *a*, front view; *b*, apertural view.
3. *Lagena stelligera*. × 75. *a*, front view; *b*, apertural view; *c*, basal view.
4. *Lagena plumigera*. × 75. *a*, front view; *b*, apertural view.
5. *Lagena desmophora*. × 90. *a*, front view; *b*, apertural view.

### PLATE 13.

ig. 1. *Lagena distoma*. × 75. *a*, front view; *b*, apertural view.
2. *Lagena distoma*. × 75. *a*, front view; *b*, apertural view.
3. *Lagena desmophora*. × 75. *a*, front view; *b*, apertural view.
4. *Lagena intermedia*. × 90. *a*, front view; *b*, apertural view.
5. *Lagena exsculpta*. × 35. *a*, front view; *b*, apertural view.

### PLATE 14.

ig. 1. *Lagena quadricostulata*. × 75.
2. *Lagena auriculata*, var. *costata*. × 60. *a*, front view; *b*, apertural view.
3. *Lagena trigono-marginata*. × 100. *a*, front view; *b*, apertural view.
4. *Lagena trigono-marginata*. × 100.
5. *Lagena striato-areolata*. × 100.
6. *Lagena striato-areolata*. × 100. Portion of the surface.
7. *Lagena ampulla-distoma*. × 60.
8. *Lagena fimbriata*. × 60.
9. *Lagena quadrata*. × 75.
10. *Lagena striato-punctata*. × 75.

### PLATE 15.

ig. 1. *Lagena feildeniana*. *a*, front view, × 150; *b*, apertural view, × 150; *c*, portion of surface enlarged, × 375.
2. *Lagena feildeniana*. × 150. Specimen with wider intercostal areas and higher, more acute costæ. *a*, front view; *b*, apertural view.
3. *Lagena foveolata*, var. *paradoxa*. *a*, front view, × 75; *b*, enlarged portion of surface, × 150.

### PLATE 16.

ig. 1. *Lagena aspera*. × 90.
2. *Lagena lagenoides*. × 150.
3. *Lagena lagenoides*, var. *tenuistriata*. × 150. *a*, front view; *b*, side view.
4. *Lagena sublagenoides*. × 75. *a*, front view; *b*, apertural view.
5. *Lagena sublagenoides*, var. *striatula*. × 75.

### PLATE 17.

ig. 1. *Lagena crescenticostata*. × 75. *a*, front view; *b*, side view.
2. *Lagena crescenticostata*. × 75. Specimen with more simple ornamentation.
3. *Lagena staphyllearia*. × 45. *a*, front view; *b*, apertural view.
4. *Lagena auriculata*, var. *subcarinata*. × 150. *a*, front view; *b*, side view.
5. *Lagena auriculata*, var. *linearituba*. × 75. *a*, front view; *b*, side view.

### PLATE 18.

ig. 1. *Lagena alveolata*. × 75. *a*, front view; *b*, side view.
2. *Lagena alveolata*, var. *plebeia*. × 90. *a*, front view; *b*, side view.
3. *Lagena alveolata*, var. *prolongata*. × 75.
4. *Lagena alveolata*, var. *basiexcavata*. × 75.
5. *Lagena alveolata*, var. *substriata*. × 75.

### PLATE 19.

Fig. 1. *Lagena orbignyana.* × 90. *a*, front view; *b*, apertural view.
2. *Lagena orbignyana*, var. *concentrica.* × 90. *a*, front view; *b*, side view.
3. *Lagena truncata.* × 45. *a*, front view; *b*, same by transmitted light; *c*, side view; *d*, apertural view.
4. *Lagena quadrata*, var. *rizzæ.* × 75.

### PLATE 20.

Fig. 1. *Lagena orbignyana*, var. *lacunata.* × 150. *a*, front view; *b*, apertural view.
2. *Lagena orbignyana*, var. *crenulata.* × 150. *a*, front view; *b*, apertural view.
3. *Lagena orbignyana*, var. *coronata.* × 45. *a*, front view; *b*, side view.

### PLATE 21.

Fig. 1. *Lagena fasciata*, var. *carinata.* × 133. *a*, front view; *b*, apertural view.
2. *Lagena marginata*, var. × 65. *a*, front view; *b*, apertural view.
3. *Lagena marginata*, var. × 65. *a*, front view; *b*, side view.
4. *Lagena apiculata.* × 45. *a*, front view; *b*, side view.

### PLATE 22.

Fig. 1. *Lagena marginata.* × 133. *a*, front view; *b*, apertural view.
2. *Lagena marginata.* × 133. *a*, front view; *b*, apertural view.
3. *Lagena marginata.* × 133. Specimen by transmitted light.
4. *Lagena marginata.* × 133. Specimen with broad keel.
5. *Lagena marginata.* × 65. Specimen with keel resembling *L. lagenoides.*
6. *Lagena marginata.* × 65. Specimen with narrow keel by transmitted light.
7. *Lagena marginata.* × 65. Specimen showing irregularly striate surface.

### PLATE 23.

Fig. 1. *Lagena orbignyana*, var. *alata.* × 150.
2. *Lagena acuticosta.* × 75. *a*, front view; *b*, apertural view.
3. *Marginulina glabra.* × 40. *a*, front view; *b*, apertural view.

## PLATE 26.

igs. 1–3. *Nodosaria pyrula*. × 30–40. 1*a*, front view; 1*b*, apertural view.

4–8. *Nodosaria pyrula*, var. *semirugosa*. Fig. 6, × 30. Others, × 15.

9–11. *Nodosaria soluta*. × 12. 10*a*, front view; 10*b*, apertural view.

12, 13. *Nodosaria raphanus*. × 15. 13*a*, front view; 13*b*, apertural view.

## PLATE 27.

ig. 1. *Nodosaria filiformis*. × 65. Outline by transmitted light.

2. *Nodosaria filiformis*. × 65.

3. *Nodosaria filiformis*. × 33. *a*, front view; *b*, apertural view.

4. *Nodosaria filiformis*. × 33. *a*, front view; *b*, same by transmitted light.

5. *Nodosaria mucronata*. × 65. *a*, front view; *b*, apertural view.

6. *Nodosaria mucronata*. × 65. Outline of chambers by transmitted light.

7. *Nodosaria mucronata*. × 65. Outlines of chambers.

8. *Nodosaria longirostrata*. *a*, front view of last two chambers × 33; *b*, apertural end × 133.

9. *Nodosaria consobrina*, var. *emaciata*. × 16. *a*, front view; *b*, apertural view.

## PLATE 28.

ig. 1. *Nodosaria communis*. × 20. *a*, front view; *b*, apertural view.

2. *Nodosaria communis*. × 33. Outline of chambers.

3. *Nodosaria hirsuta*. × 65.

4. *Nodosaria japonica*. *a*, front view; × 12; *b*, last-formed chamber, × 50; *c*, apertural view, × 50.

5. *Nodosaria simplex*. × 33. *a*, front view; *b*, apertural view.

6. *Nodosaria* (*Glandulina*) *rotundata*. × 33. *a*, front view; *b*, apertural view.

7. *Nodosaria abyssorum*. × 33. *a*, front view; *b*, apertural view.

## PLATE 29.

ig. 1. *Frondicularia robusta*, var. *repanda*. × 30. *a*, front view; *b*, apertural view.

2. *Frondicularia robusta*, var. *repanda*. × 30. A more irregular specimen.

3. *Lingulina carinata*. × 20. *a*, front view; *b*, apertural view.

4. *Cristellaria cultrata*. × 25. *a*, side view; *b*, face view.

5. *Cristellaria crepidula*. × 90. Outline of chambers.

6. *Cristellaria crepidula*. × 60. Outline of chambers.

## PLATE 30.

g. 1. *Vaginulina protumida*. × 30.

2. *Polymorphina ovata*. × 25. *a*, front view; *b*, apertural view.

3. *Polymorphina sororia*. × 75. *a*, front view; *b*, apertural view.

4. *Cristellaria reniformis*. × 35. *a*, side view; *b*, face view.

5. *Cristellaria subalata*. × 25. Side view.

6. *Cristellaria subalata*. × 60. Basal wing.

7. *Cristellaria subalata*. × 60. Basal wing, × 60.

## PLATE 31.

g. 1. *Cristellaria articulata*. × 30. *a*, side view; *b*, face view.

2. *Cristellaria crepidula*. × 60.

3. *Cristellaria crepidula*. × 30. *a*, face view; *b*, side view.

4. *Cristellaria crepidula*. × 60. Outline of chambers.

5. *Cristellaria crepidula*. × 150. Outlines of chambers by transmitted light.

## PLATE 32.

Fig. 1. *Nodosaria vertebralis*. × 15.
2. *Cristellaria nitida*. × 30. *a*, side view; *b*, face view.
3. *Cristellaria vortex*. × 30. *a*, side view; *b*, face view.
4. *Cristellaria calcar*. × 35.
5. *Frondicularia robusta*. × 17.
6. *Frondicularia robusta*. × 75. *a*, front view; *b*, apertural view.
7. *Vaginulina patens*. × 75. *a*, side view; *b*, face view.
8. *Vaginulina patens*. × 75.

## PLATE 33.

Fig. 1. *Cristellaria reniformis*. × 30. *a*, side view; *b*, face view.
2. *Cristellaria tricarinella*, var. *spinipes*. × 30. *a*, side view; *b*, face view.
3. *Cristellaria italica*. × 30. *a*, side view; *b*, face view.
4. *Cristellaria wetherellii*, var. *sublineata*. × 18. *a*, side view; *b*, face view.

## PLATE 34.

Fig. 1. *Cristellaria tricarinella*. × 50. *a*, side view; *b*, face view.
2. *Cristellaria tricarinella*. × 50.
3. *Cristellaria convergens*. × 50. *a*, side view; *b*, face view.
4. *Cristellaria costata*. × 35.
5. *Cristellaria echinata*. × 20.
6. *Cristellaria mamilligera*. × 20. *a*, side view; *b*, face view.
7. *Cristellaria gemmata*. × 35. *a*, side view; *b*, face view.
8. *Polymorphina lactea*. × 50.

## PLATE 35.

Fig. 1. *Cristellaria gibba*. × 40. *a*, side view; *b*, face view.
2. *Cristellaria acutauricularis*. × 133. *a*, side view; *b*, face view.
3. *Cristellaria rotulata*. × 20. *a*, side view; *b*, face view.
4. *Cristellaria lata*. × 80. *a*, side view; *b*, face view.
5. *Nodosaria guttifera*. × 33. *a*, front view; *b*, apertural view.

## PLATE 38.

ig. 1. *Polymorphina elegantissima.* × 33. *a*, front view; *b*, side view; *c*, apertural view.
2. *Cristellaria latifrons.* × 80. *a*, side view; *b*, face view.
3. *Cristellaria* sp. × 33. *a*, side view; *b*, face view.
4. *Cristellaria* sp. × 33. *a*, side view; *b*, face view.
5. *Lagena lævis.* × 133.
6. *Lagena acuta.* × 100. *a*, front view; *b*, same by transmitted light; *c*, apertural view.

## PLATE 39.

ig. 1. *Ramulina globulifera.* × 33. *a*, elongated specimen; *b*, globular portion.
2. *Triplasia tricarinata.* × 80. *a*, specimen with irregular contour; *b*, specimen with regular contour; *c*, apertural view.
3. *Triplasia reussii.* × 65. *a*, side view; *b*, apertural view.
4. *Vaginulina legumen.* × 33. *a*, side view; *b*, apertural view.
5. *Frondicularia bradyi.* × 160. Specimen by transmitted light showing very thick proloculum with radiating tubes.
6. *Polymorphina angusta.* × 65. *a*, side view; *b*, front view; *c*, rear view; *d*, apertural view.

## PLATE 40.

ig. 1. *Polymorphina rotundata.* × 30. *a*, front view; *b*, side view; *c*, apertural view.
2. *Polymorphina lanceolata.* × 60. *a*, front view; *b*, apertural view.
3. *Polymorphina compressa.* × 30. *a*, front view; *b*, apertural view.
4. *Polymorphina ovata*, fistulose form. × 60. *a*, ventral view; *b*, apertural view; *c*, dorsal view.

## PLATE 41.

ig. 1. *Polymorphina longicollis.* × 65. *a*, front view; *b*, apertural view; *c*, side view.
2. *Polymorphina longicollis.* × 65. *a*, front view; *b*, side view.
3. *Polymorphina longicollis*, fistulose form. × 33. *a*, front view; *b*, apertural view.
4. *Polymorphina gibba.* × 33. *a*, front view; *b*, apertural view.
5. *Polymorphina amygdaloides.* × 80. *a*, front view; *b*, apertural view.
6. *Polymorphina regina.* × 65. Young specimen.
7. *Polymorphina regina.* × 65. *a*, front view; *b*, apertural view.
8. *Polymorphina lactea*, var. *diffusa.* × 33. *a*, front view; *b*, apertural view.

## PLATE 42.

g. 1. *Uvigerina pygmæa.* × 60. *a*, front view; *b*, apertural view.
2. *Uvigerina proboscidea.* × 60. *a*, front view; *b*, apertural view.
3. *Uvigerina ampullacea.* × 30. *a*, front view; *b*, side view.
4. *Uvigerina tenuistriata.* × 60. *a*, front view; *b*, apertural view.
5. *Uvigerina selseyensis.* × 120. *a*, front view; *b*, apertural view.
6. *Uvigerina canariensis.* × 60. *a*, front view; *b*, side view; *c*, apertural view.

## PLATE 43.

g. 1. *Uvigerina asperula.* × 65. *a*, front view; *b*, apertural view.
2. *Uvigerina brunnensis.* × 65. *a*, front view; *b*, side view; *c*, apertural view.
3. *Uvigerina angulosa*, var. *spinipes.* × 65. *a*, front view; *b*, apertural view.
4. *Uvigerina aculeata.* × 33. *a*, front view; *b*, side view; *c*, apertural view.
5. *Uvigerina striata.* × 65. *a*, front view; *b*, apertural view.

## PLATE 44.

Fig. 1. *Uvigerina interrupta*. × 75. *a*, front view; *b*, side view; *c*, apertural view.
2. *Uvigerina porrecta*. × 75. *a*, front view; *b*, front view; *c*, apertural view, a more attenuate specimen.
3. *Uvigerina striatula*. × 75. *a*, front view; *b*, side view; *c*, apertural view.
4. *Uvigerina angulosa*. × 75. *a*, front view; *b*, side view; *c*, apertural view.
5. *Uvigerina pygmæa*. × 75.

## PLATE 45.

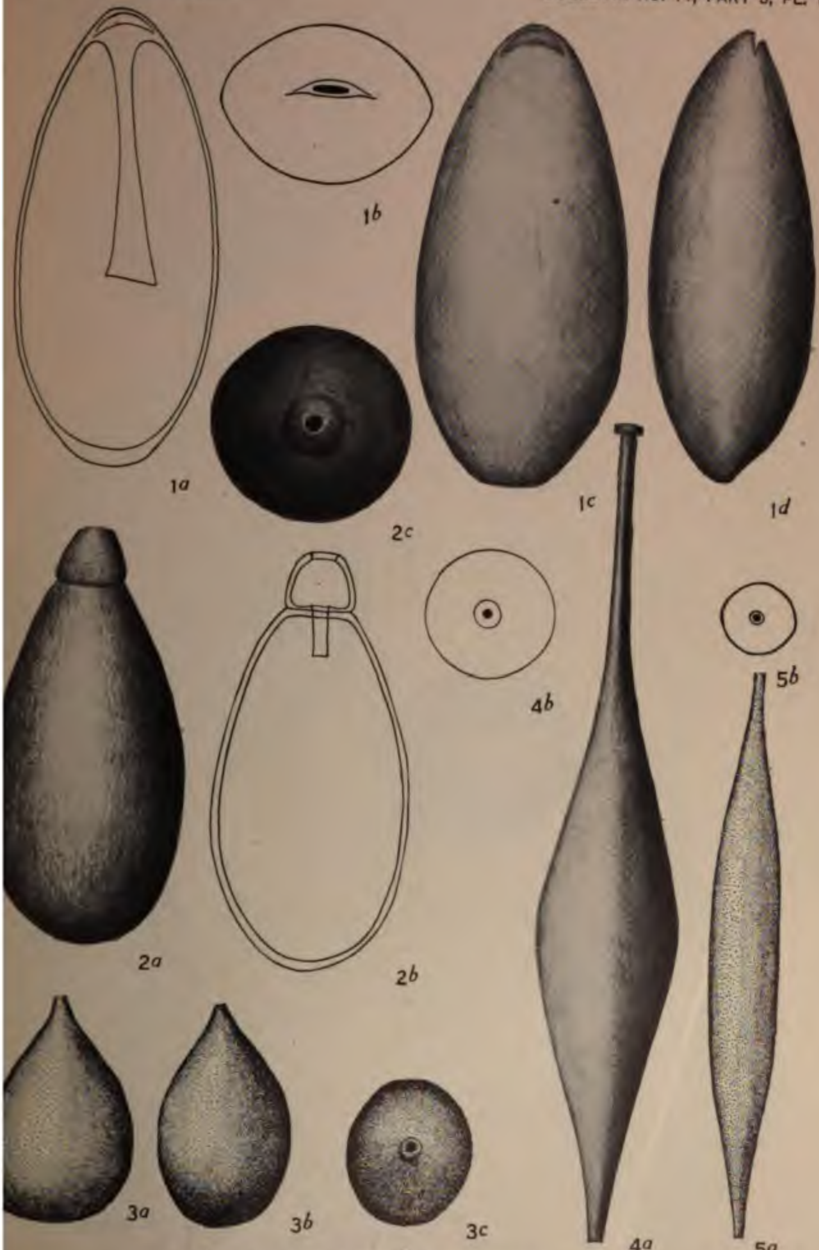
Fig. 1. *Siphogenerina bifrons*. × 75. *a*, front view; *b*, apertural view, microspheric specimen.
2. *Siphogenerina bifrons*. × 75. Megalospheric specimen.
3. *Siphogenerina dimorpha*. × 75. *a*, front view; *b*, apertural view.
4. *Siphogenerina dimorpha*. × 150. Later chambers by transmitted light.
5. *Siphogenerina bifrons*. × 300. Outline of early chamber of microspheric specimen.
6. *Siphogenerina bifrons*. × 75. Outline of megalospheric specimen by transmitted light.
7. *Siphogenerina bifrons*. × 300. Later chambers by transmitted light.

## PLATE 46.

Fig. 1. *Siphogenerina raphanus*. × 40. Megalospheric specimen.
2. *Siphogenerina raphanus*. × 40. *a*, front view; *b*, apertural view, microspheric specimen.
3. *Siphogenerina raphanus*. × 225. Outline of early chambers of microspheric specimen.
4. *Siphogenerina raphanus*. × 75. Outline of megalospheric specimen.
5. *Siphogenerina raphanus*. × 75. Later chambers by transmitted light.

## PLATE 47.

Fig. 1. *Siphogenerina striatula*. × 75. *a*, front view; *b*, apertural view.



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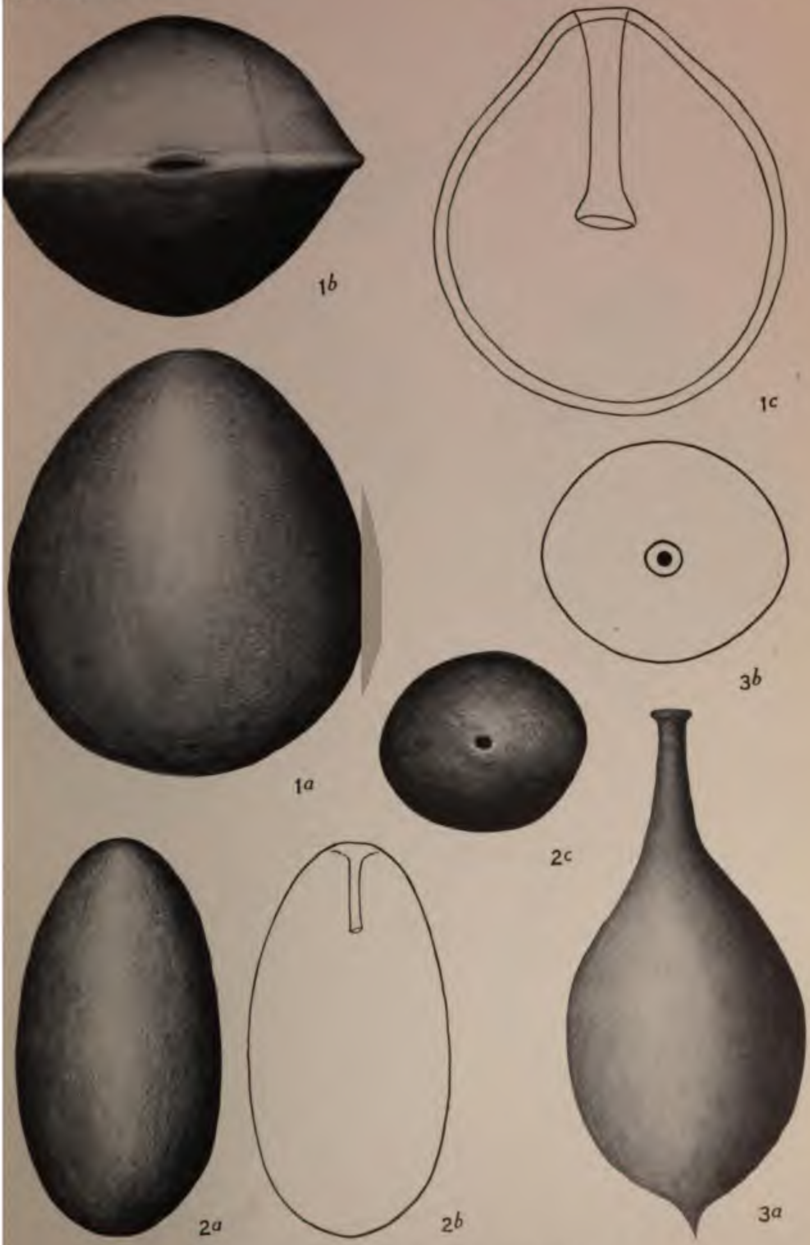

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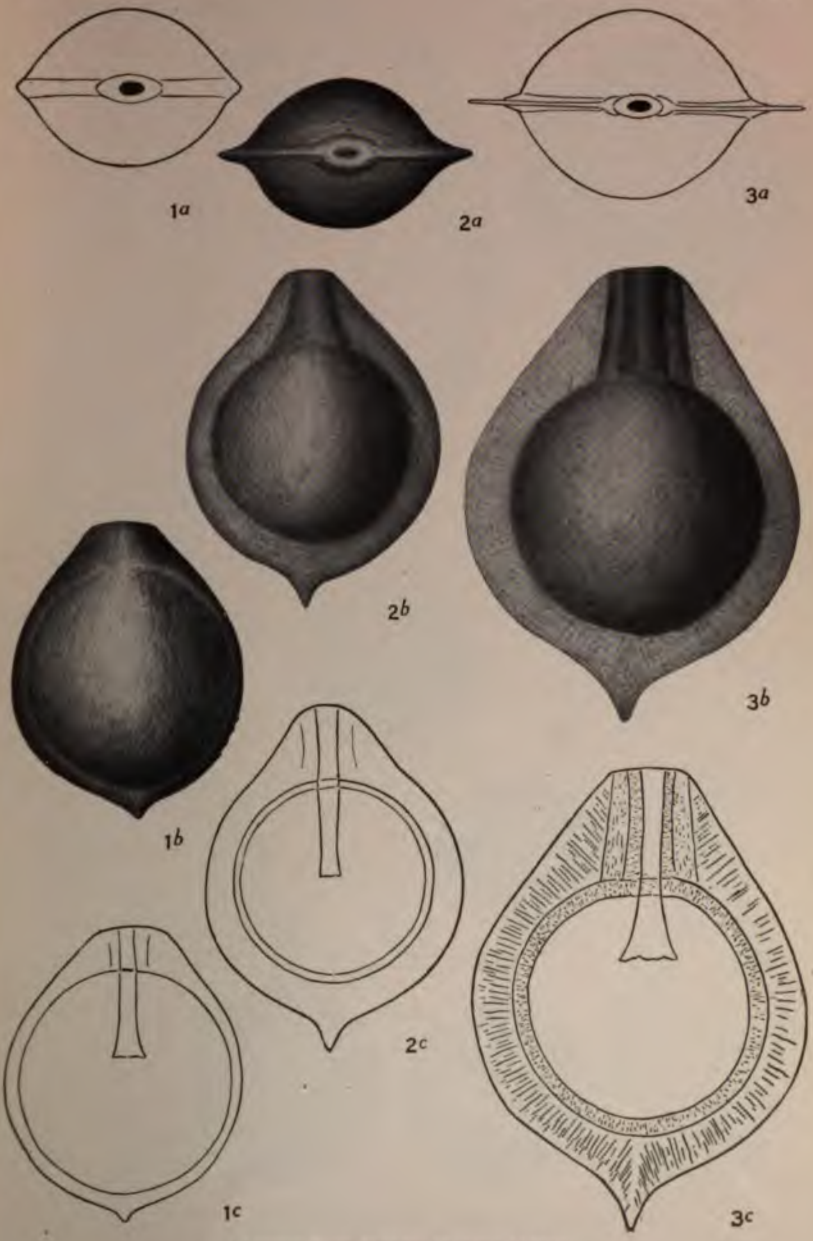

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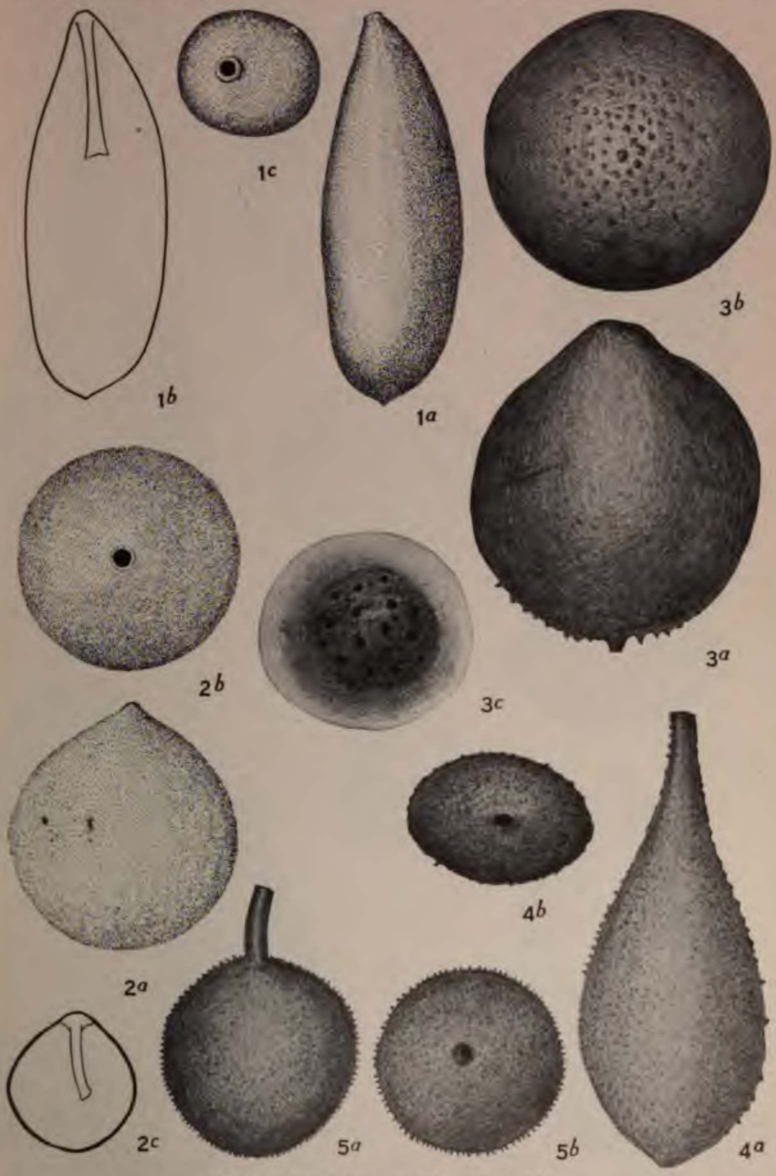

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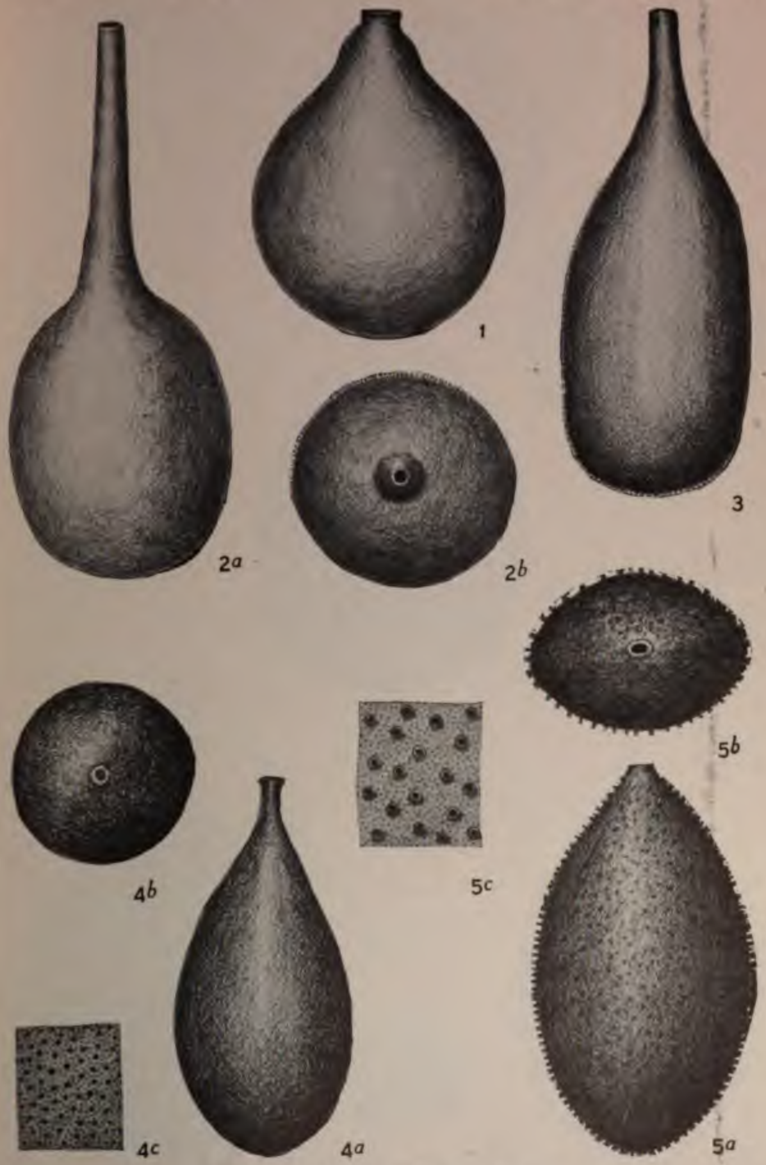

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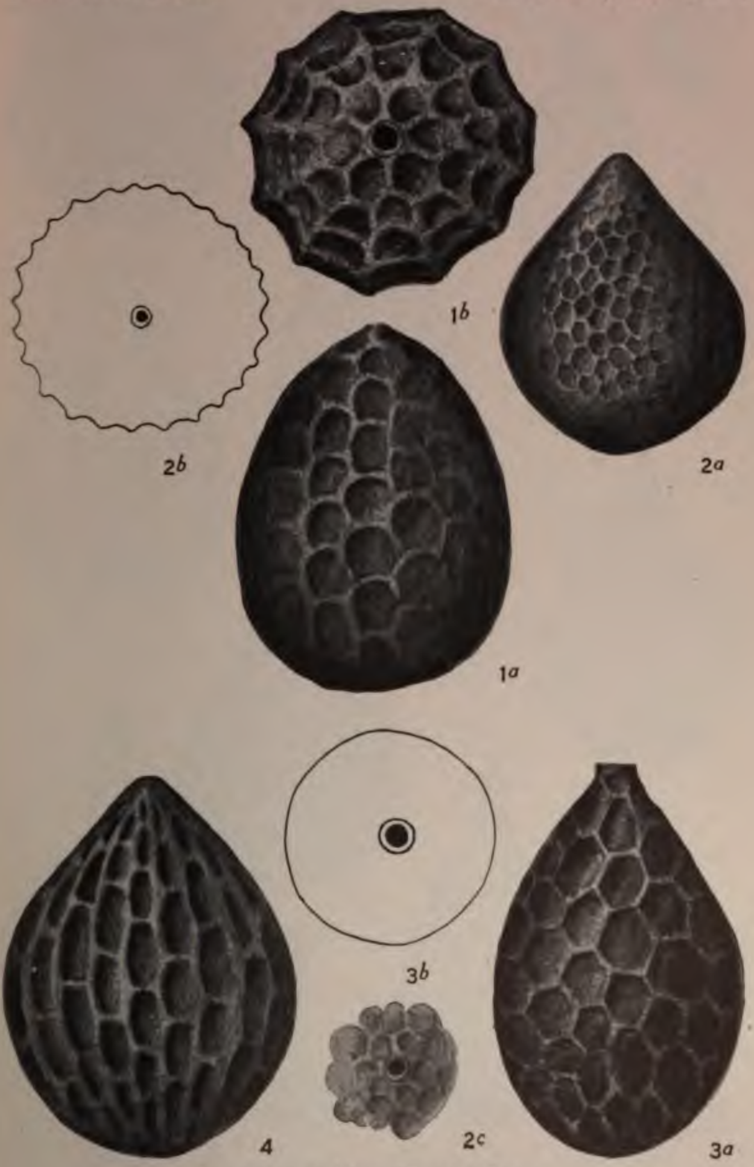

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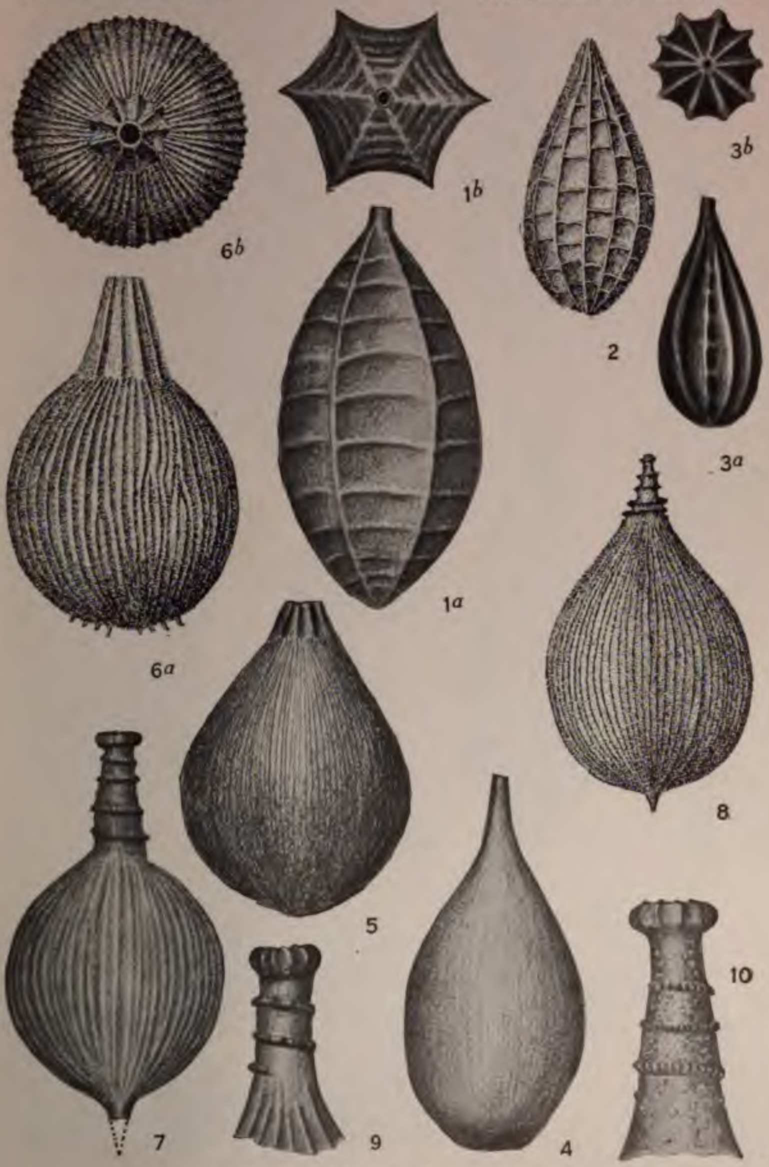

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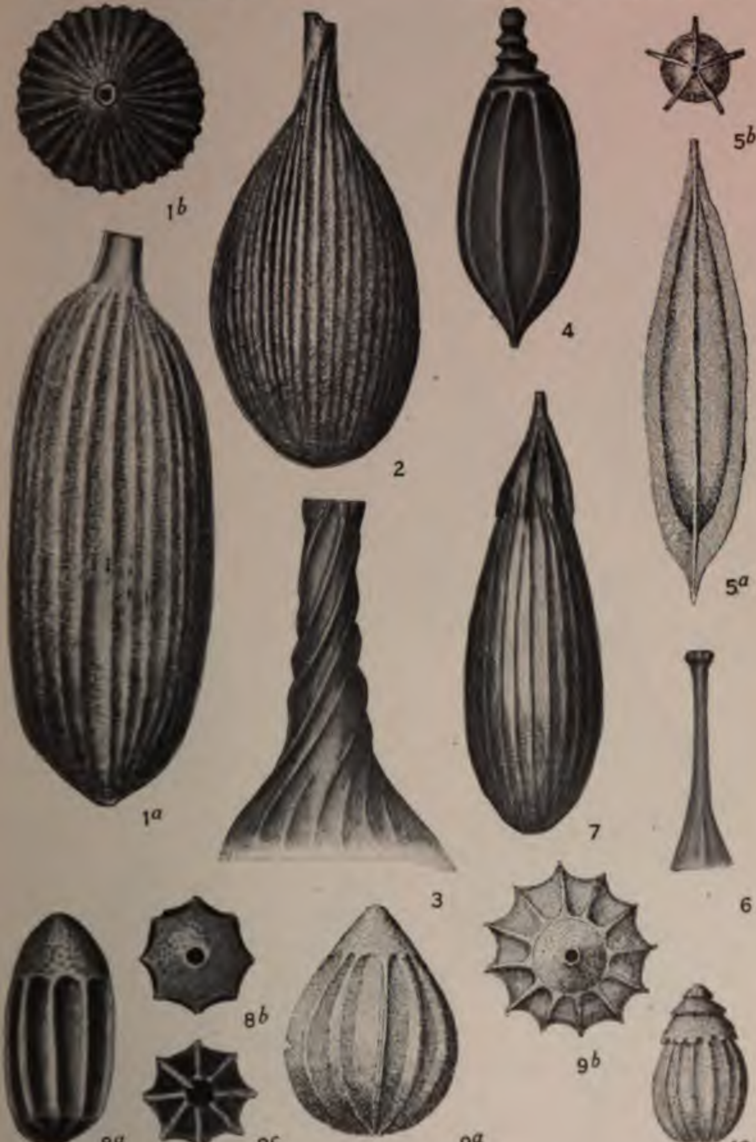

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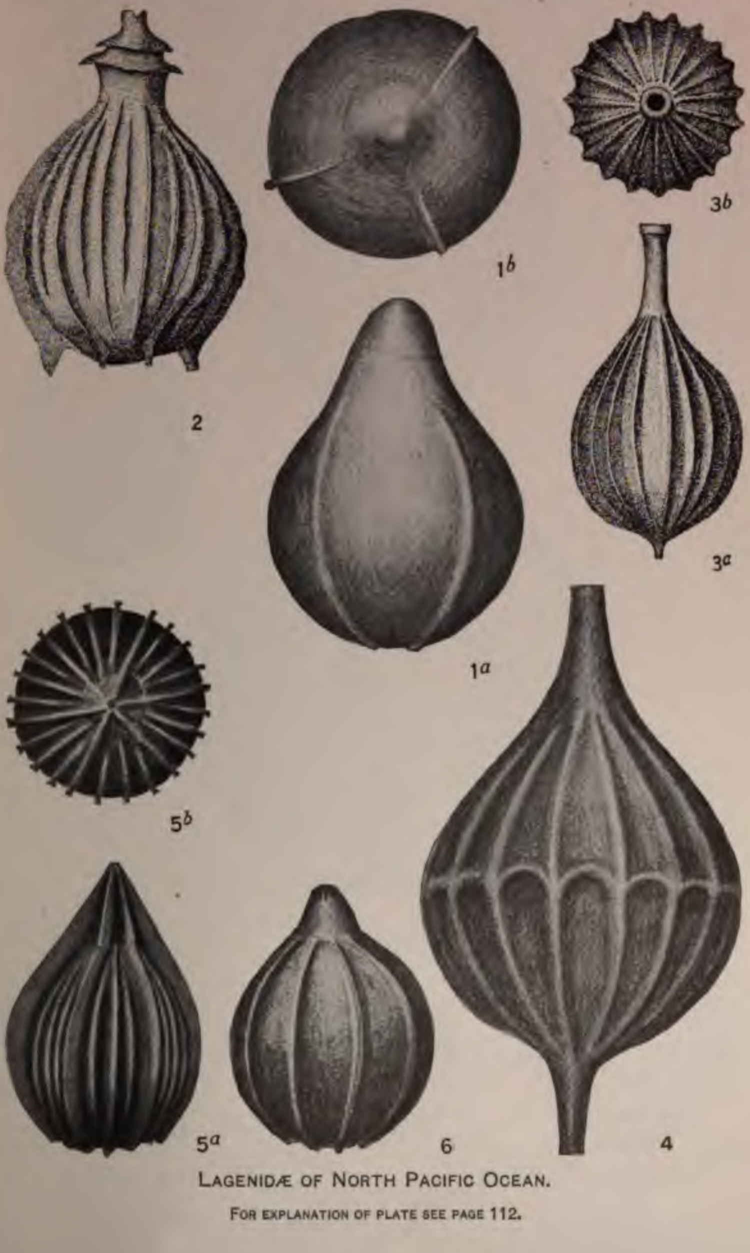

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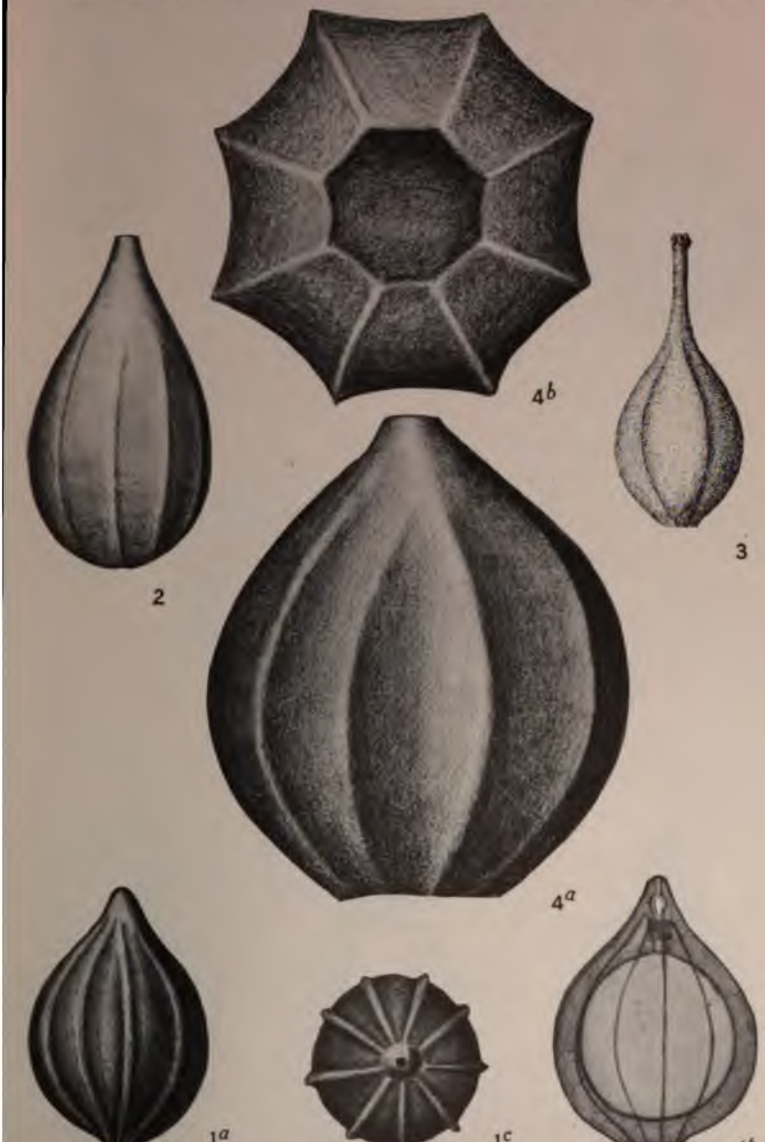

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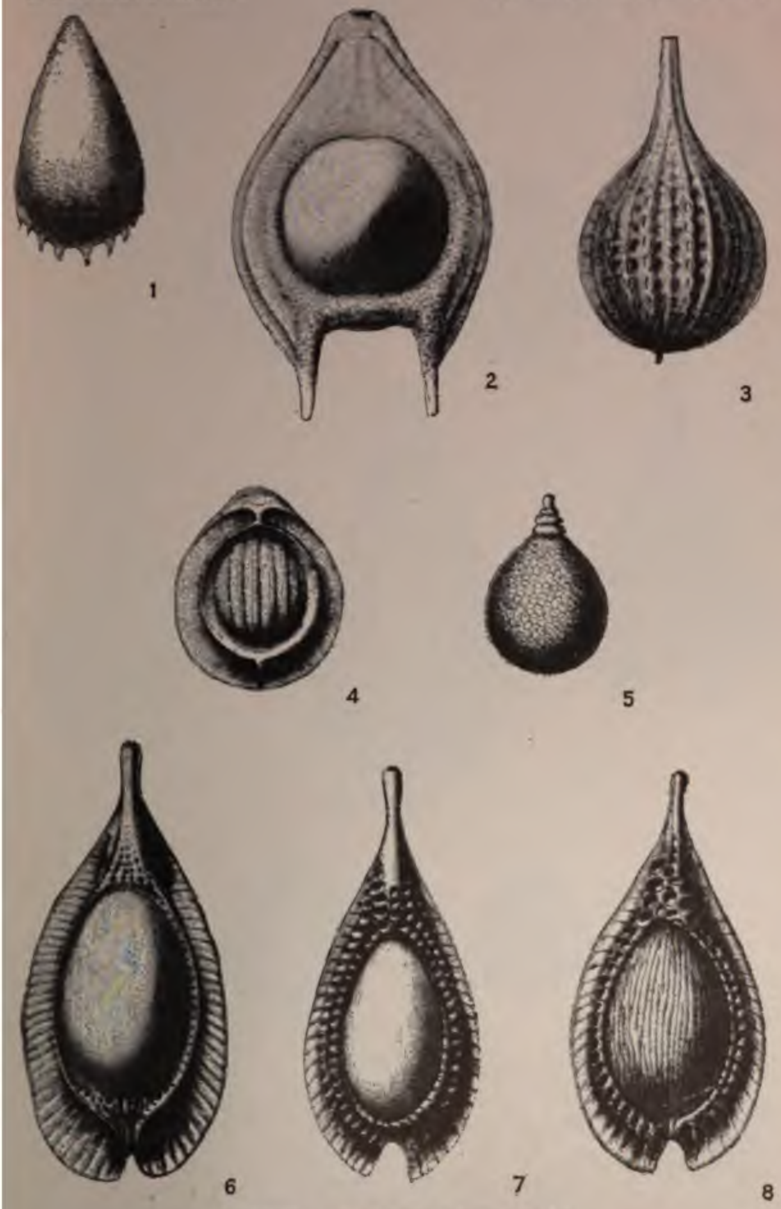

Lagenidæ of North Pacific Ocean.

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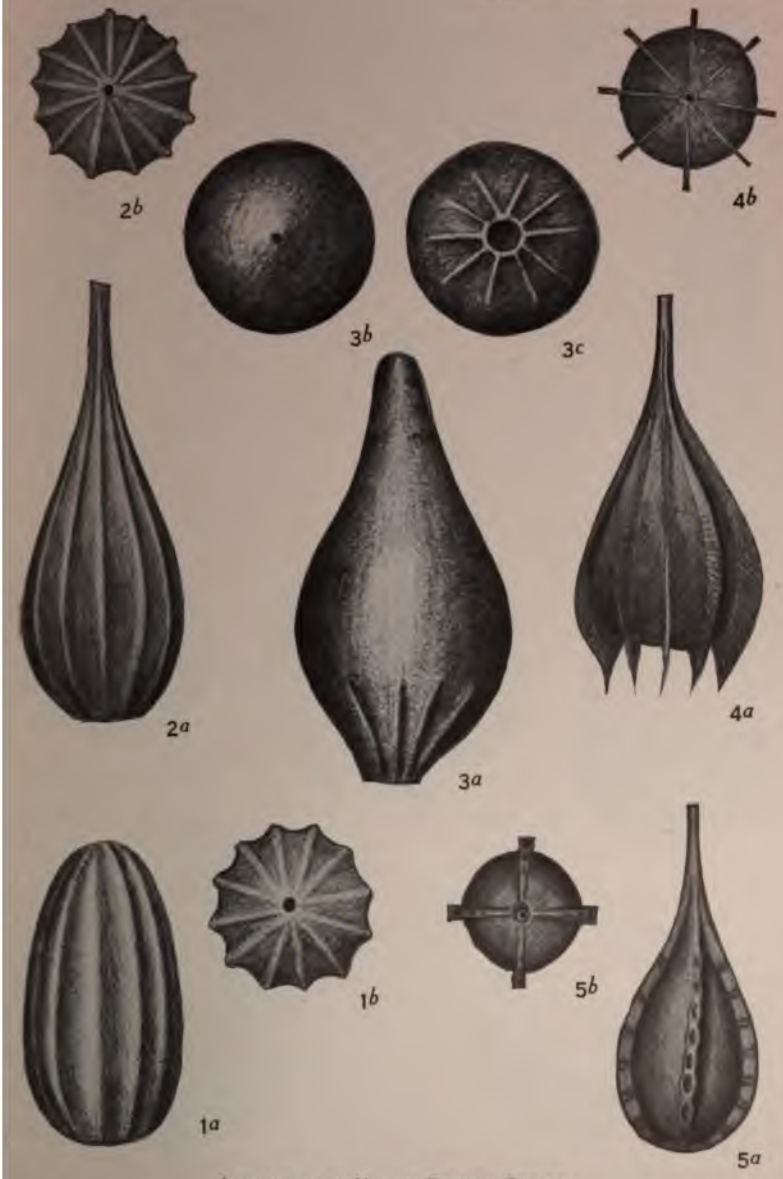

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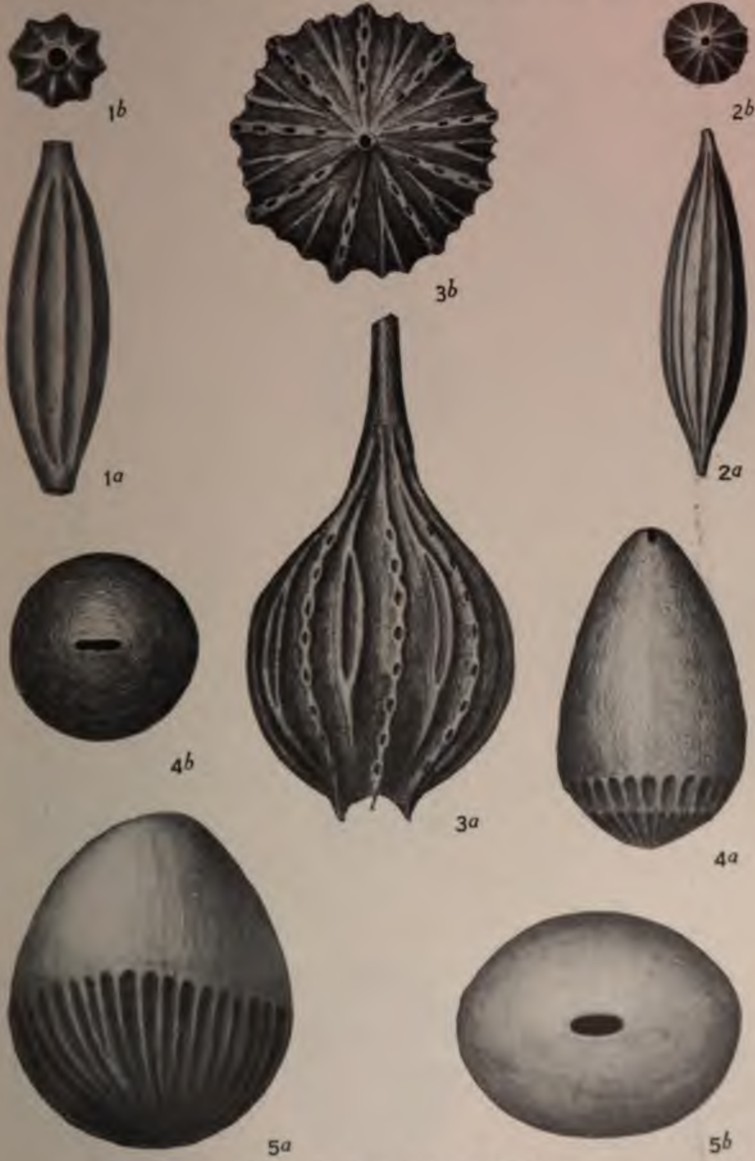

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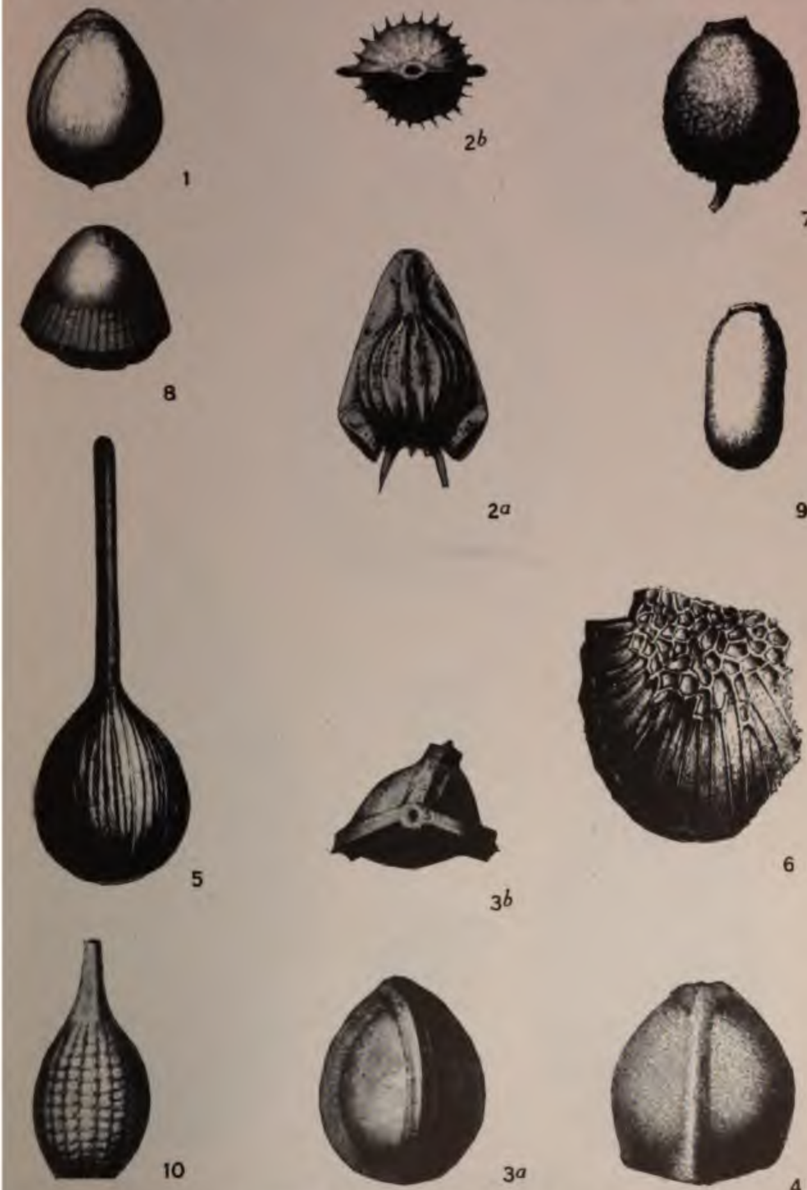

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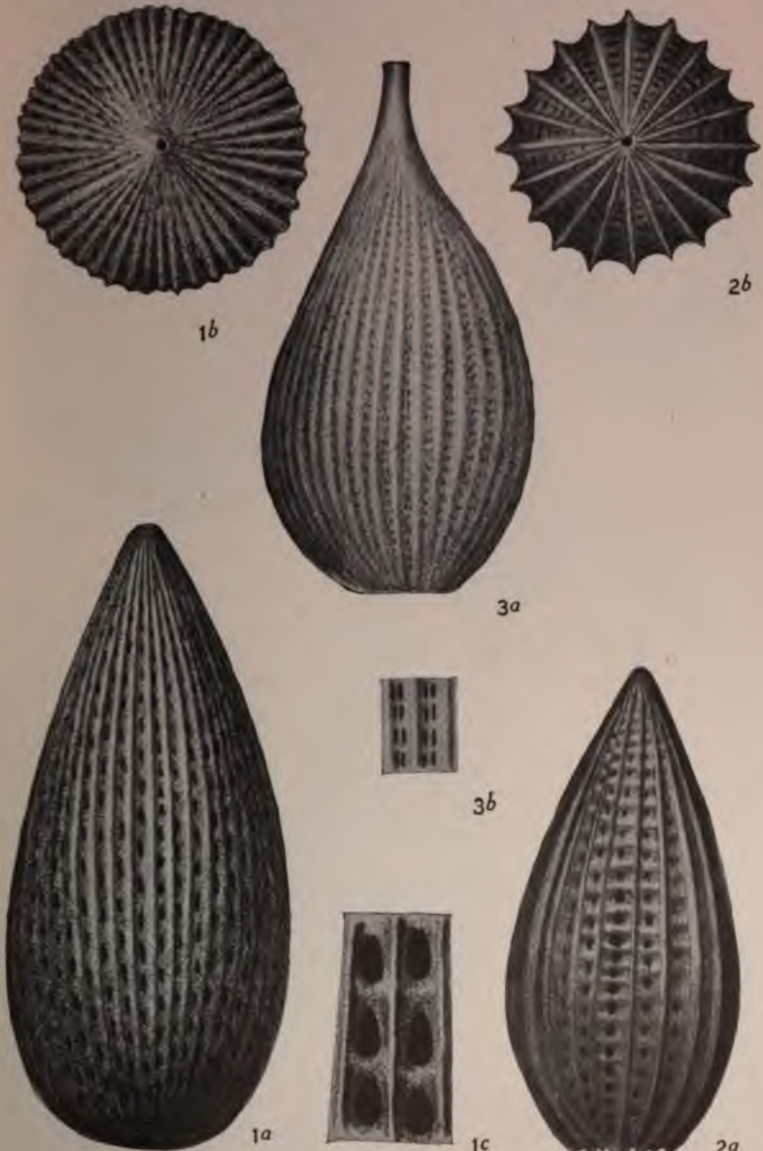

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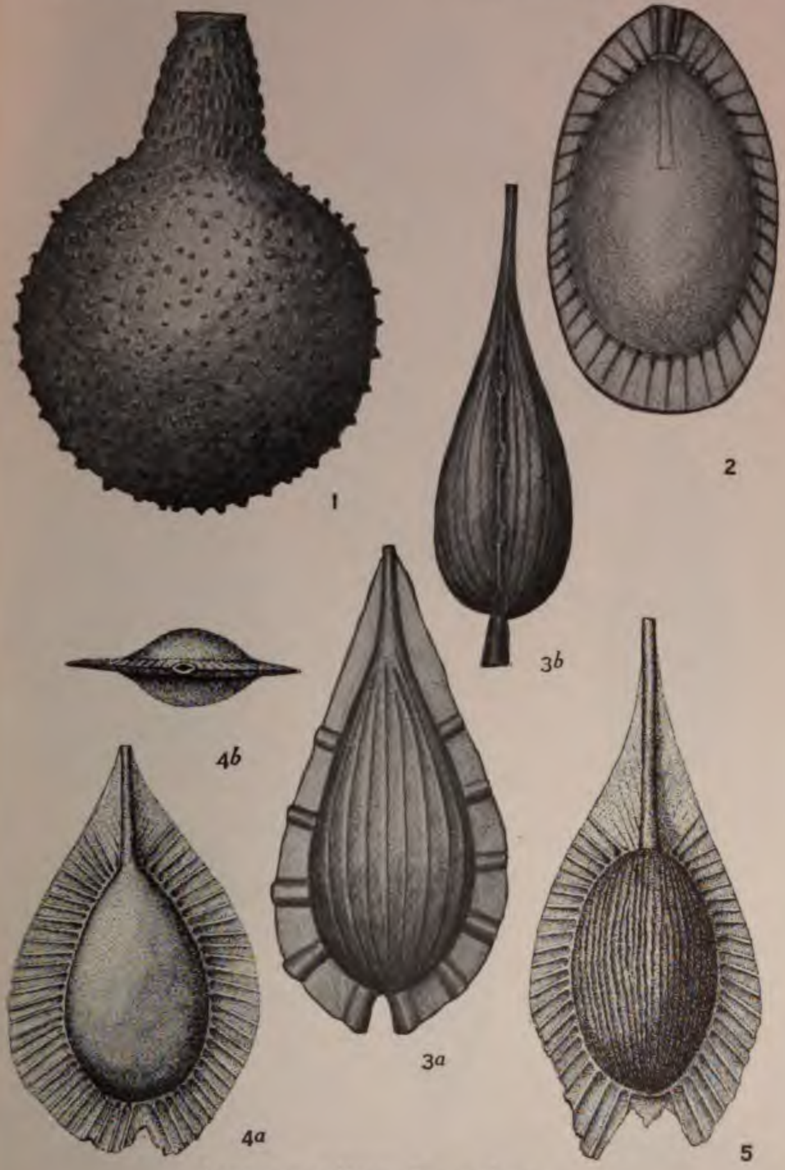

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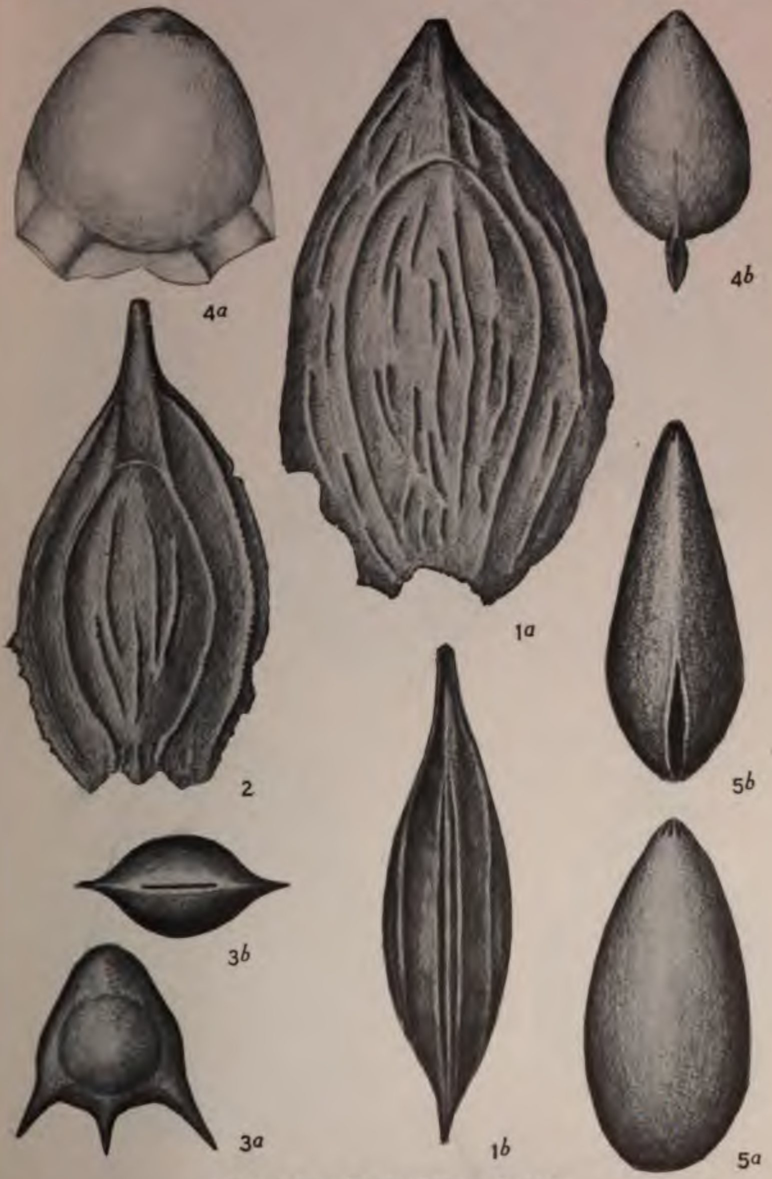

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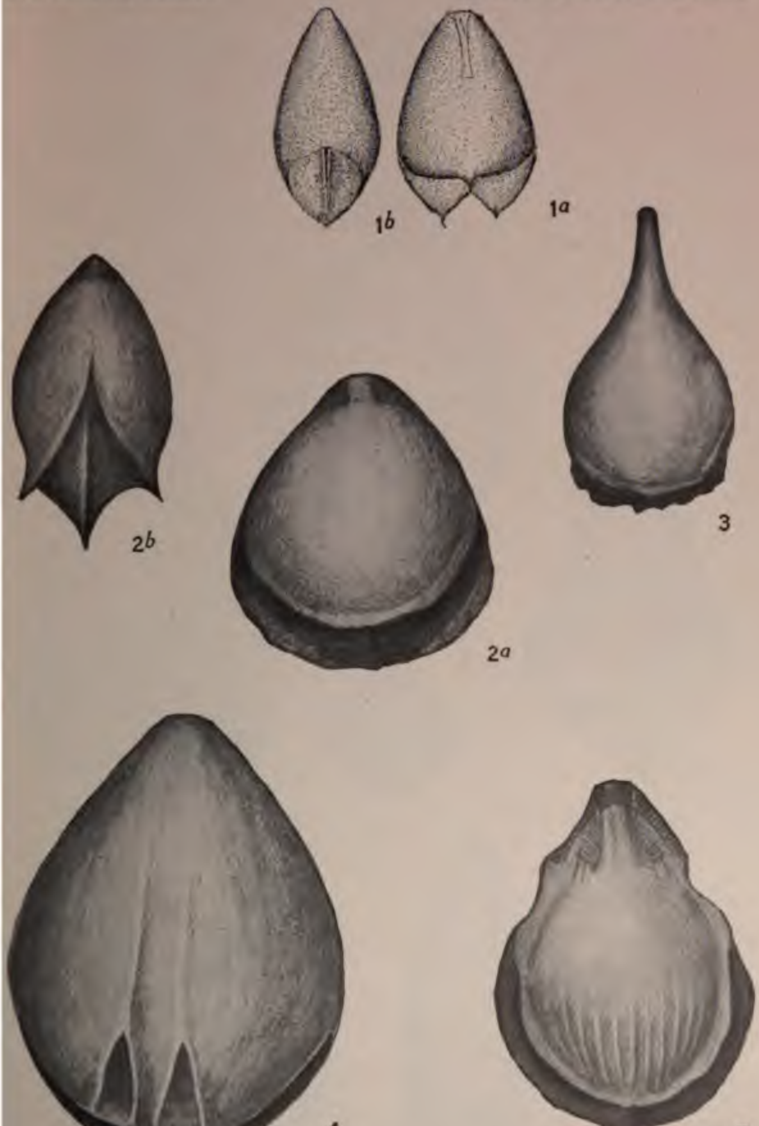

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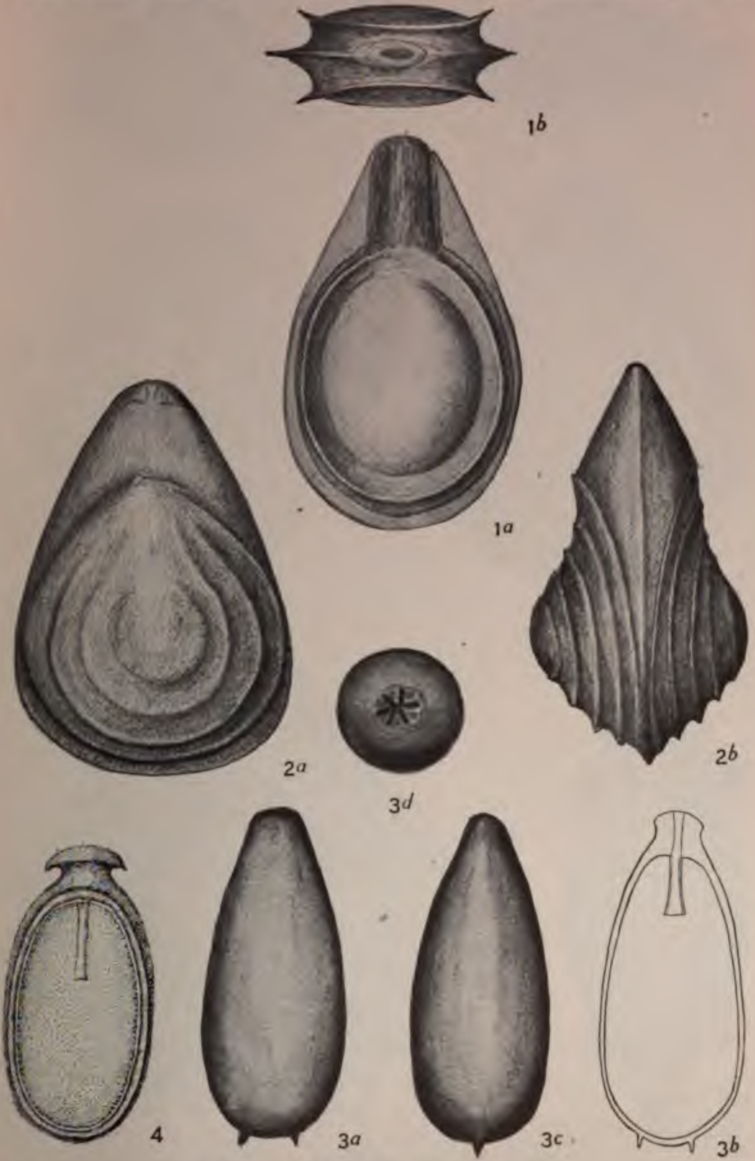

Lagenidæ of North Pacific Ocean.

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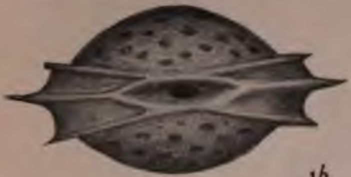

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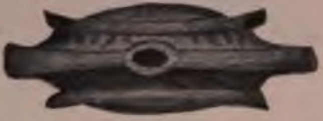

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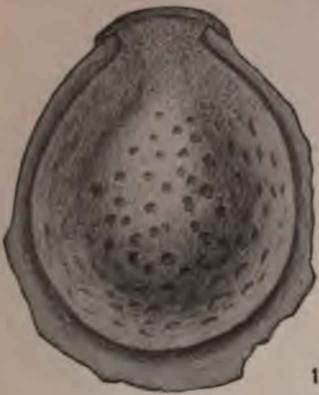

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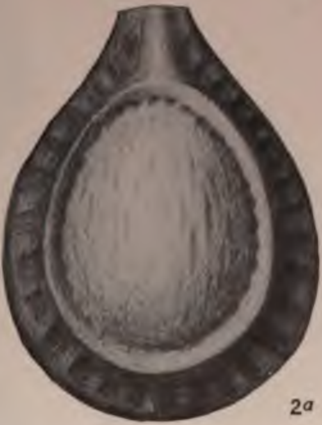

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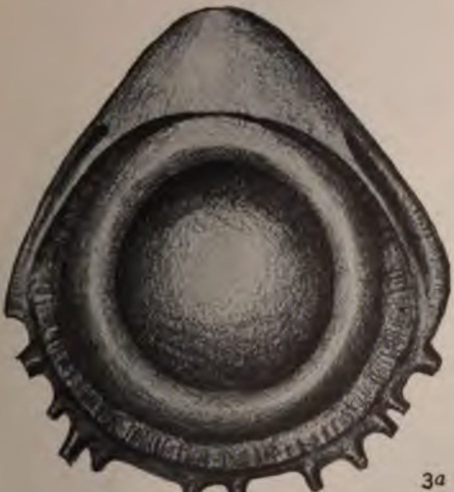

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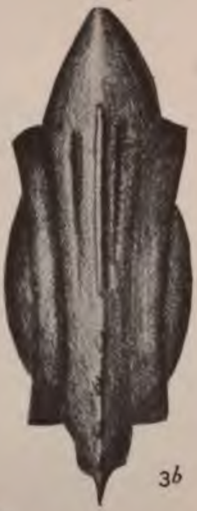

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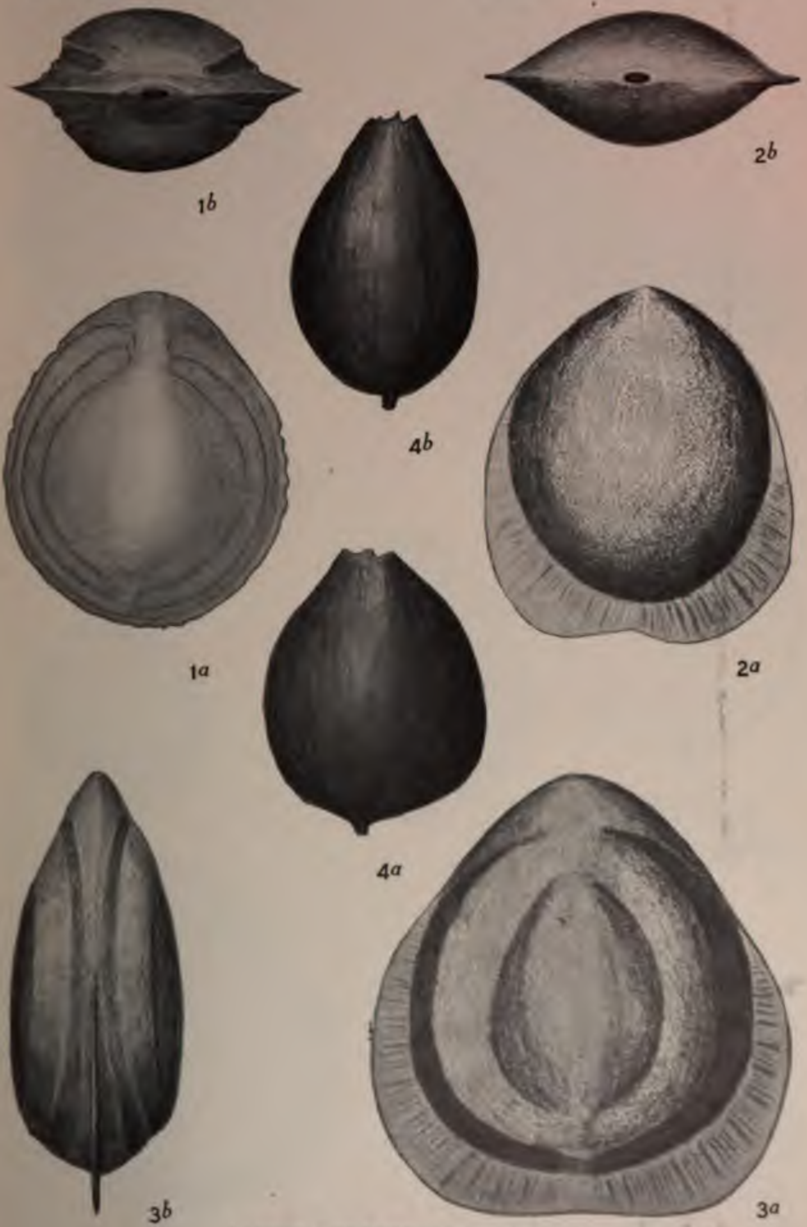

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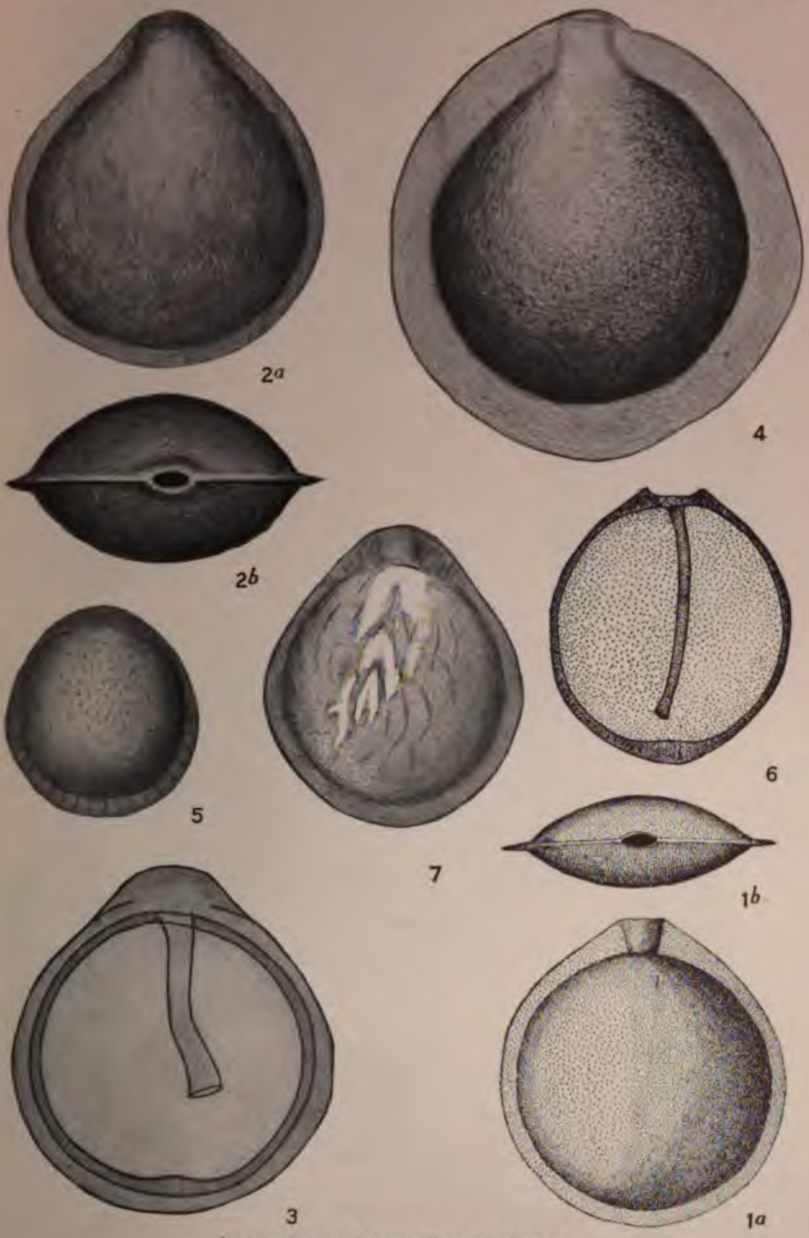

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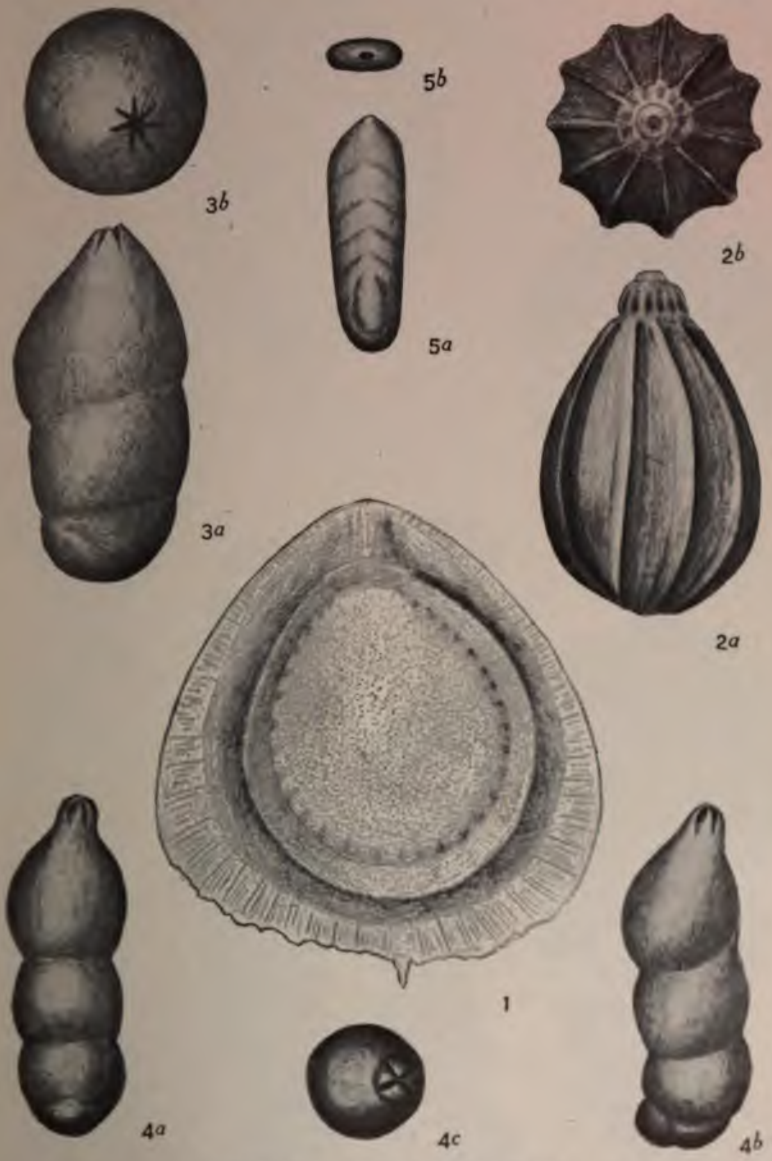

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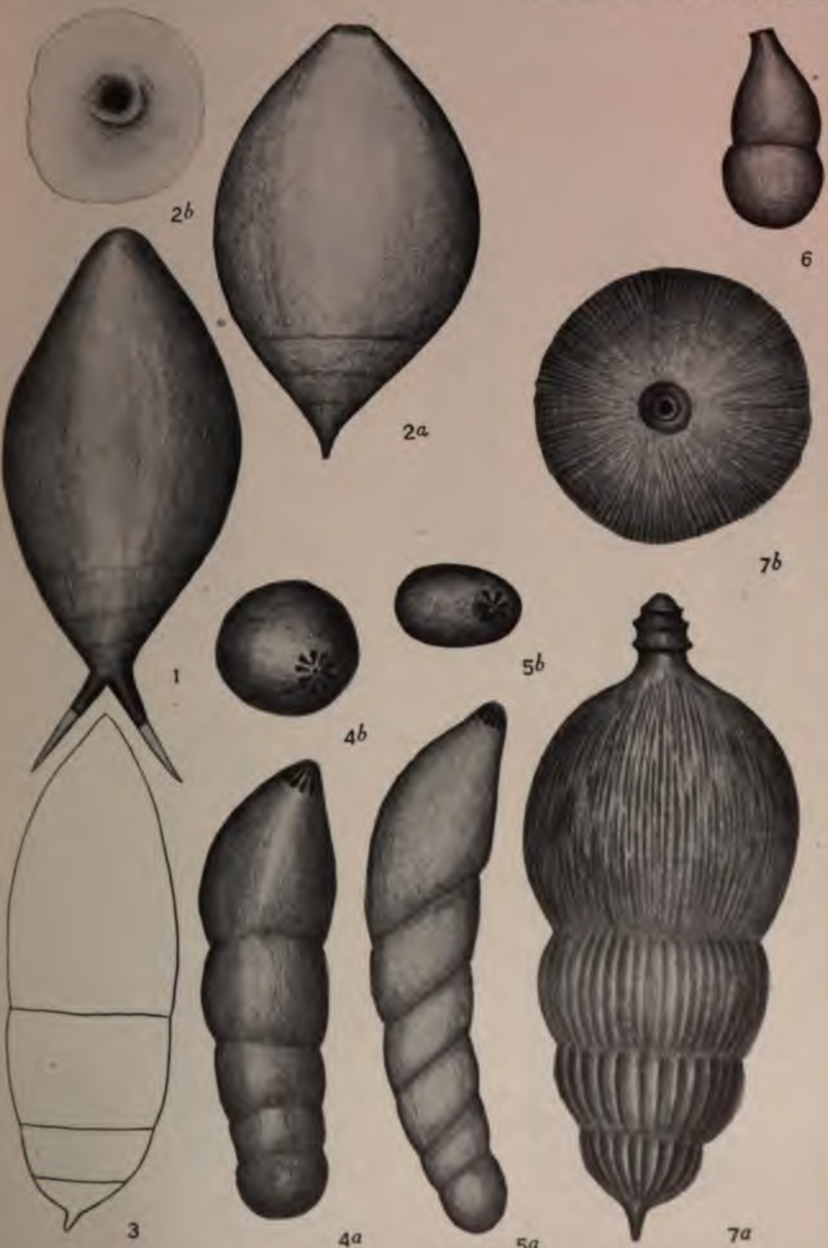

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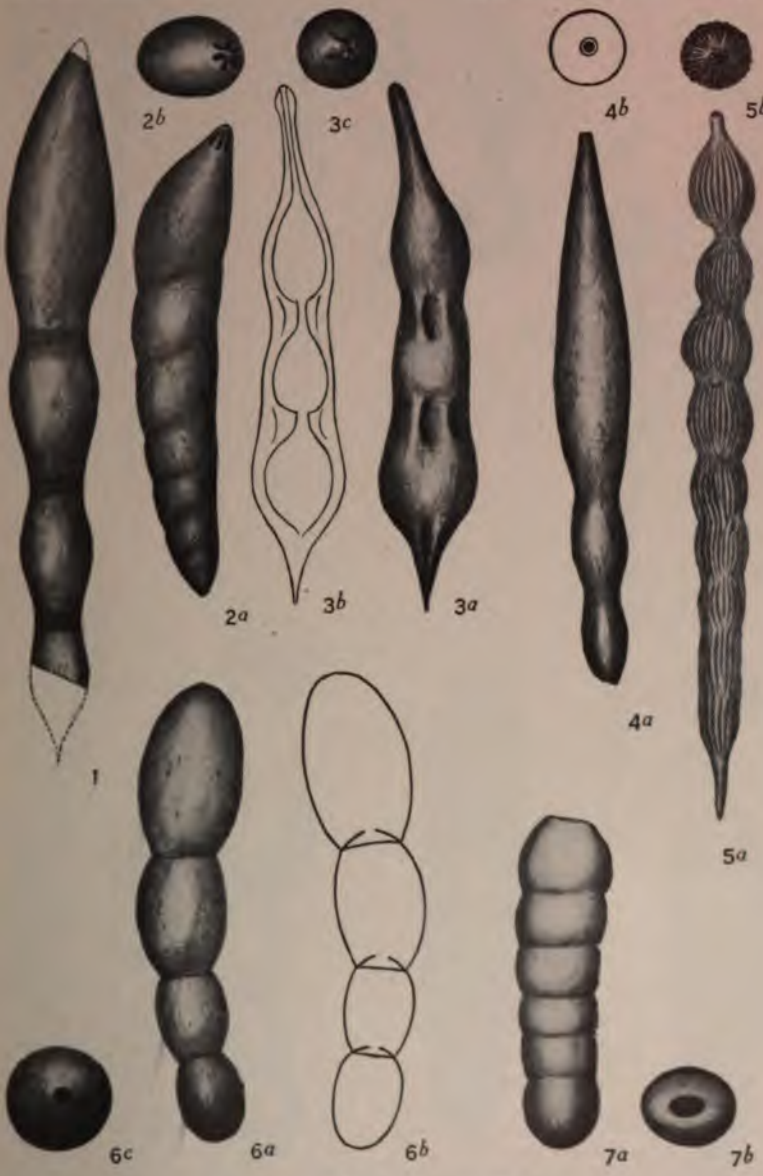

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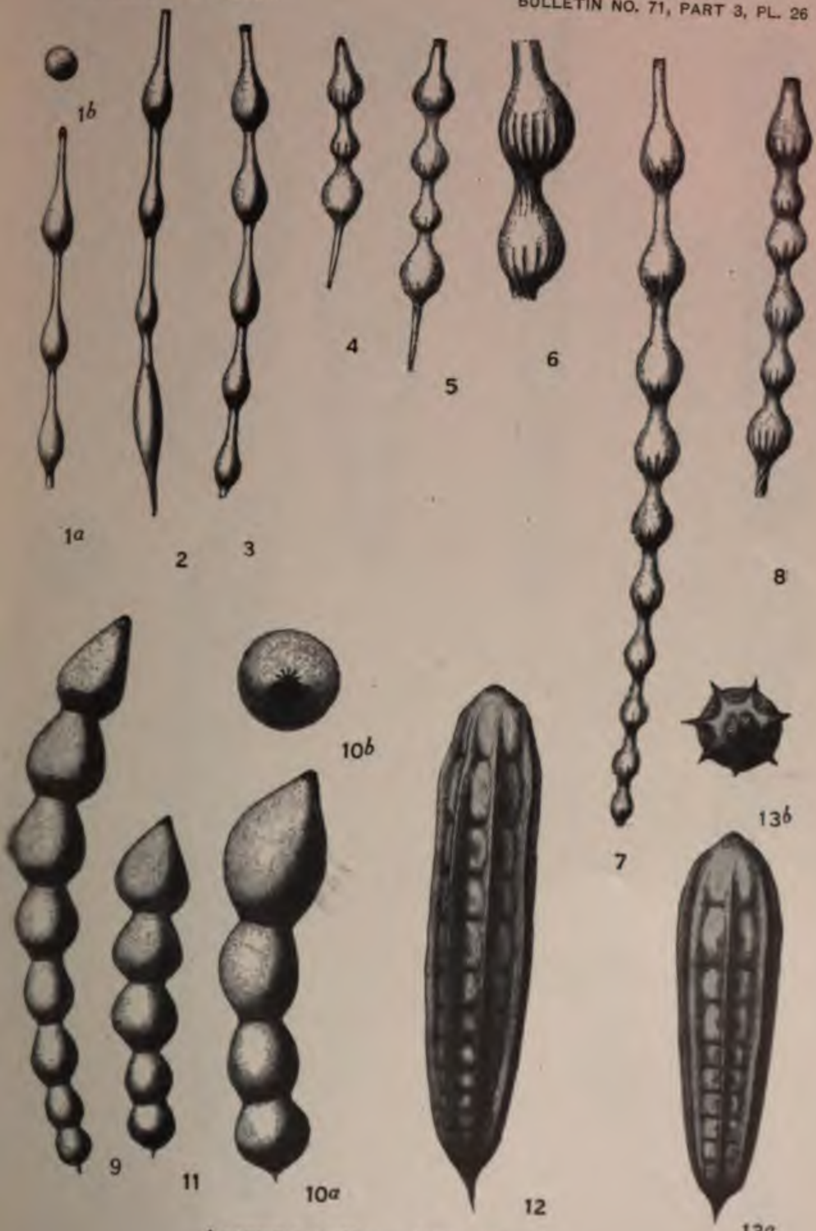

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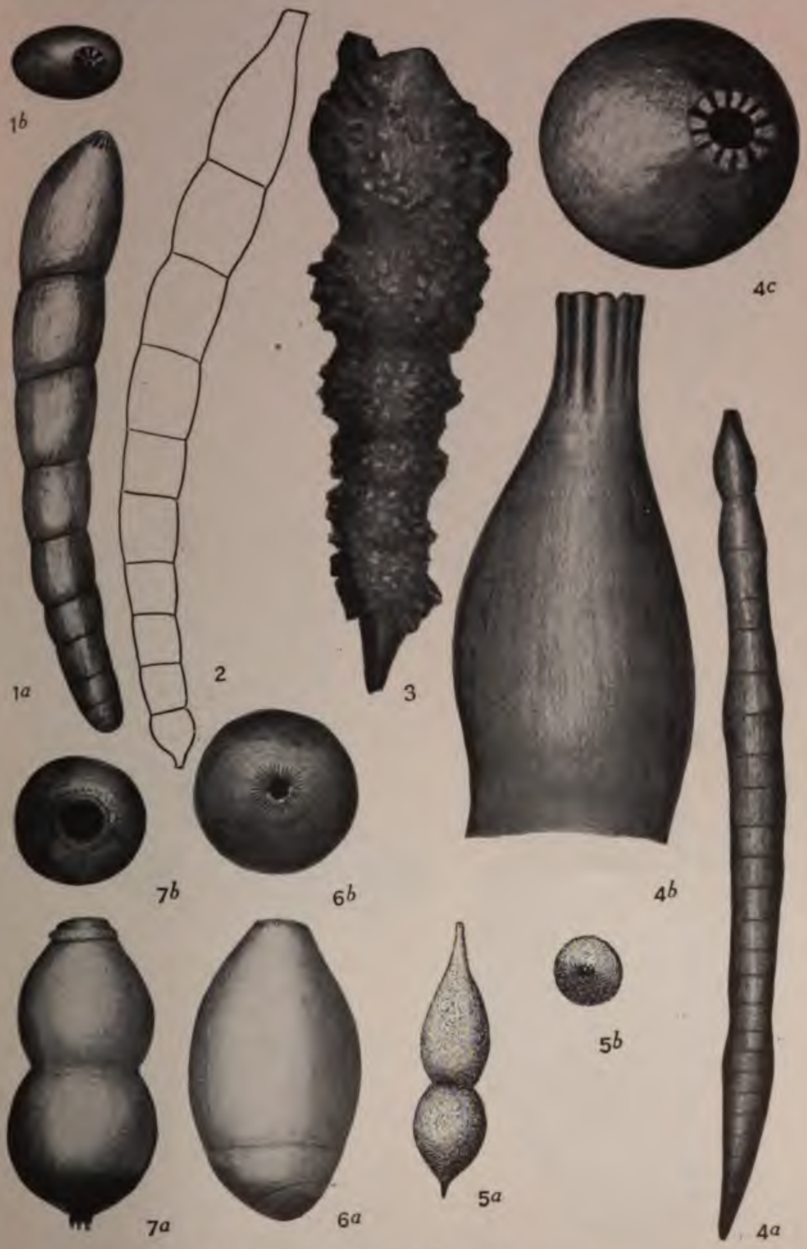

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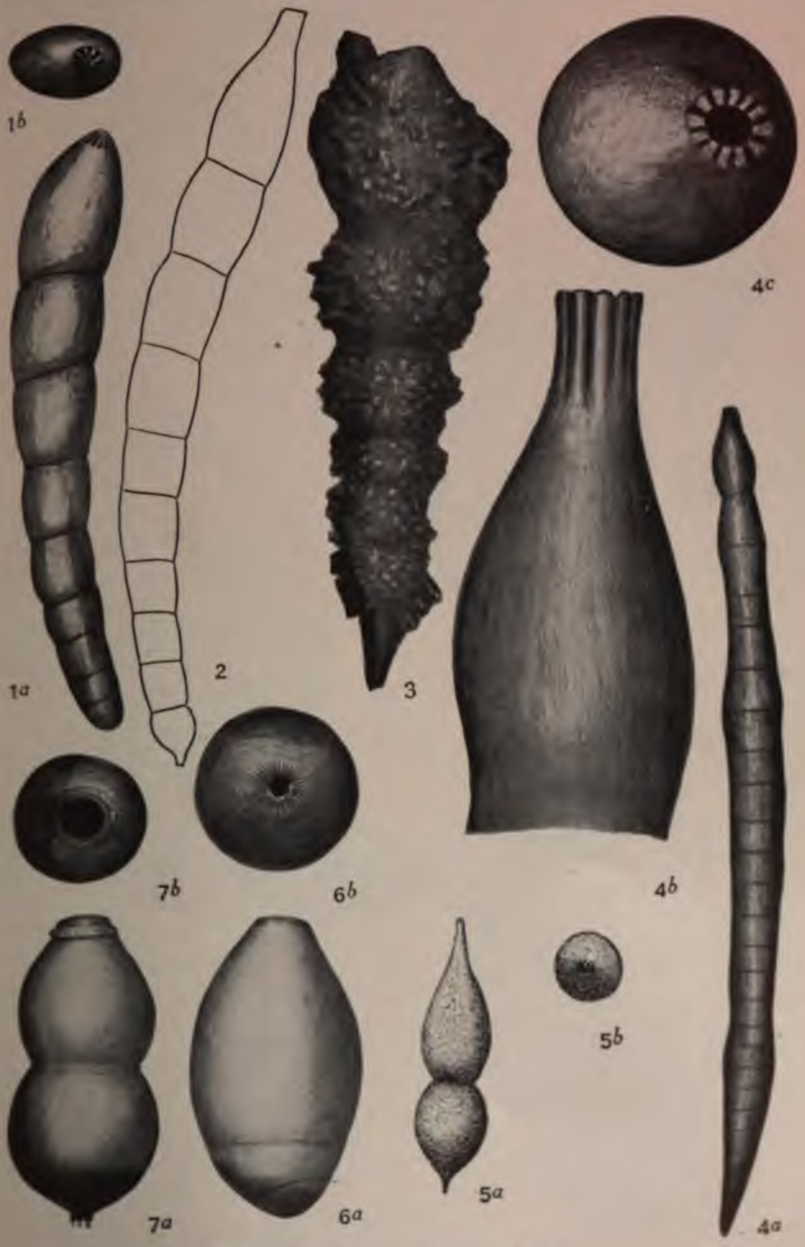

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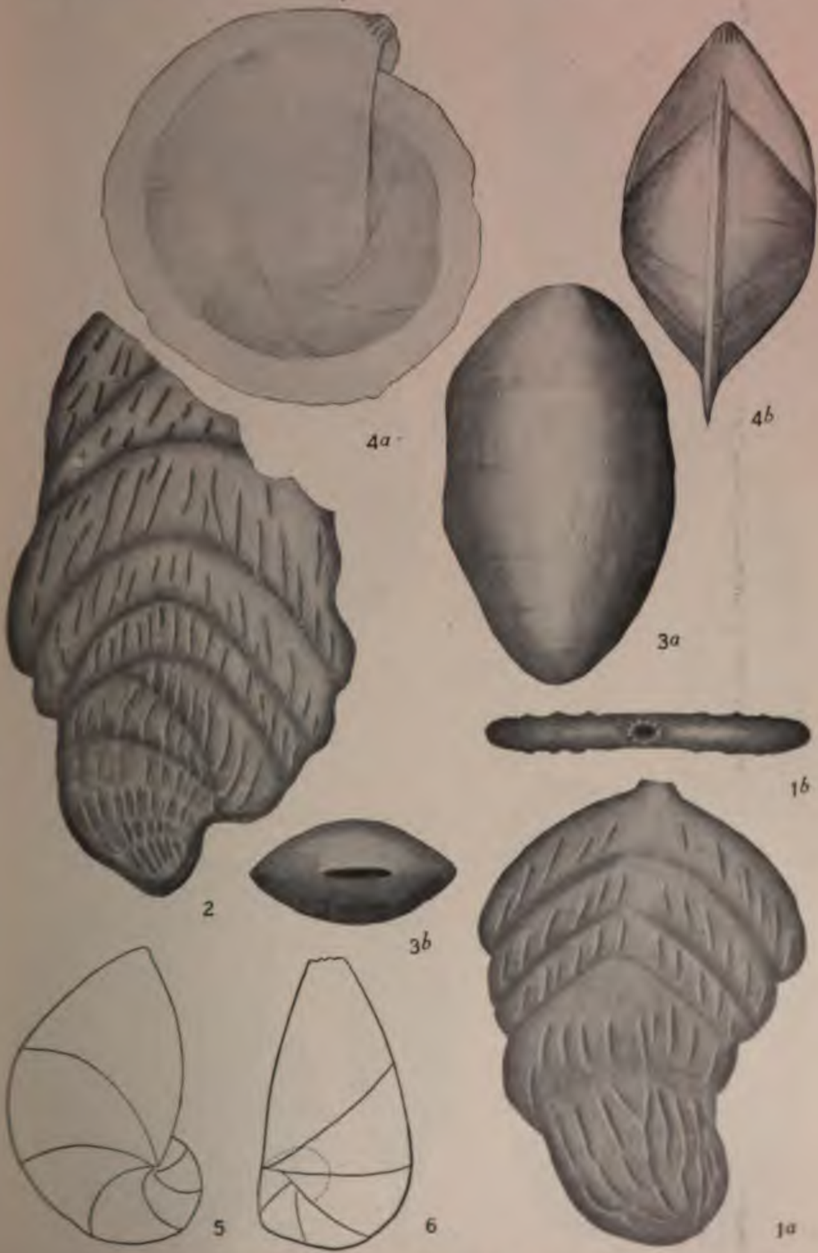

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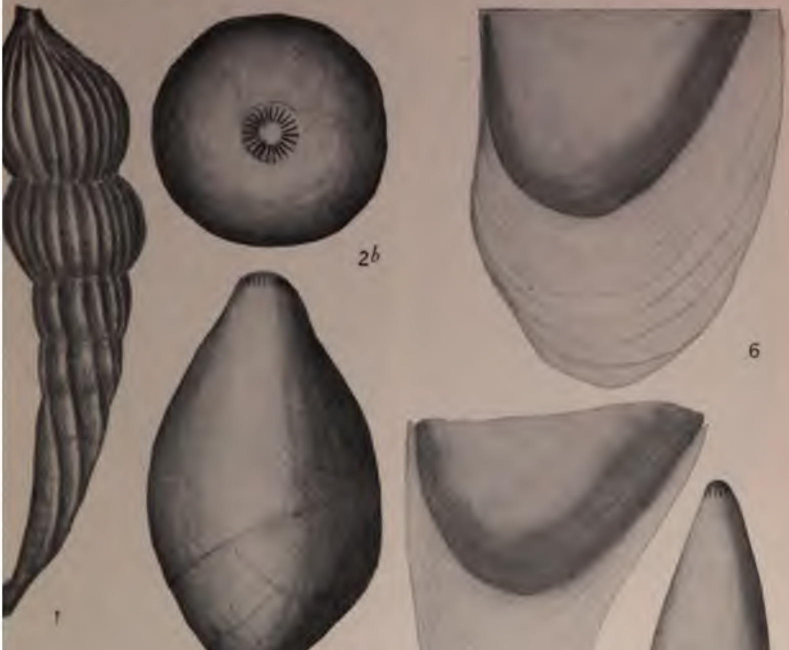

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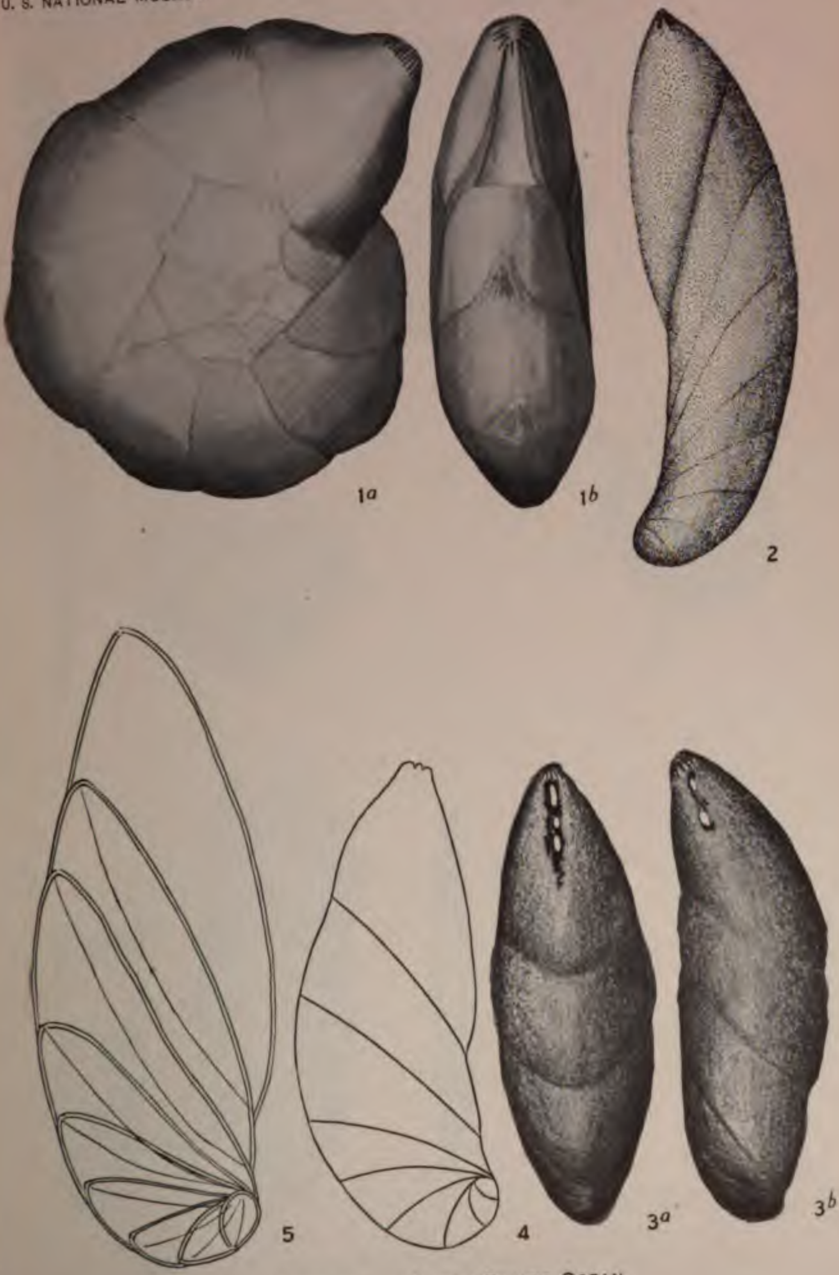

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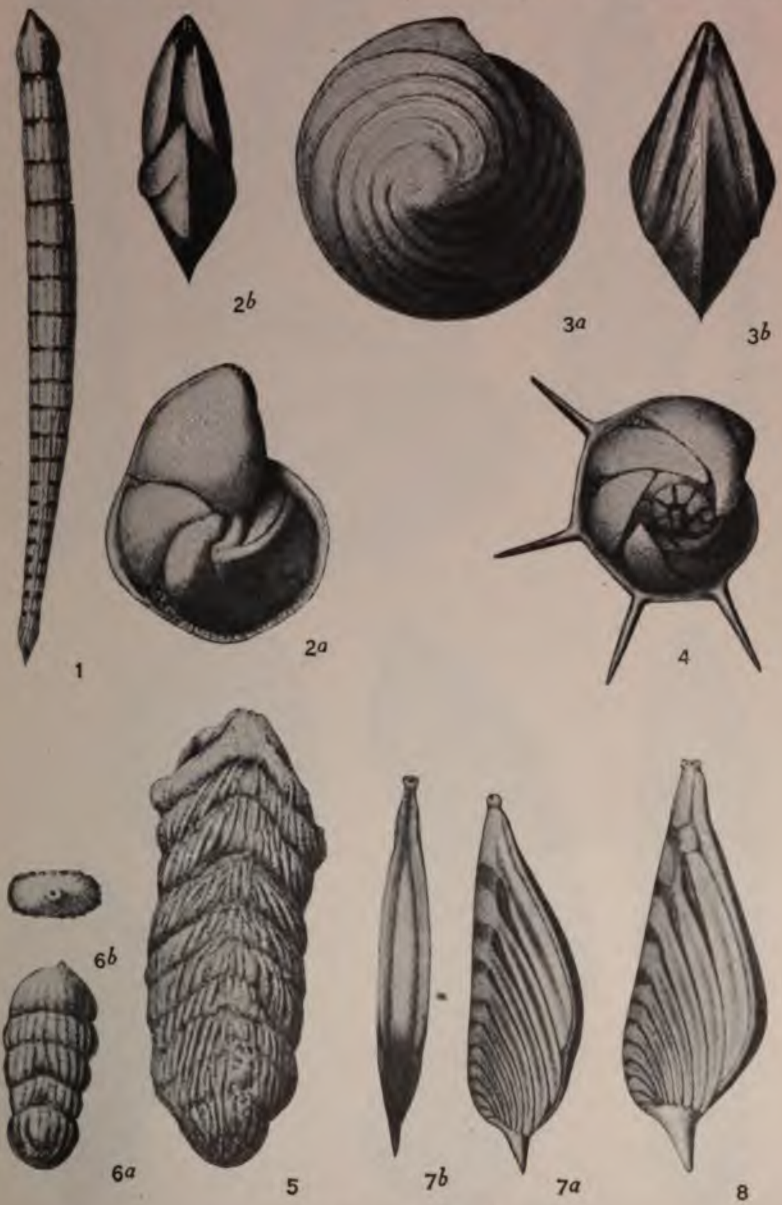

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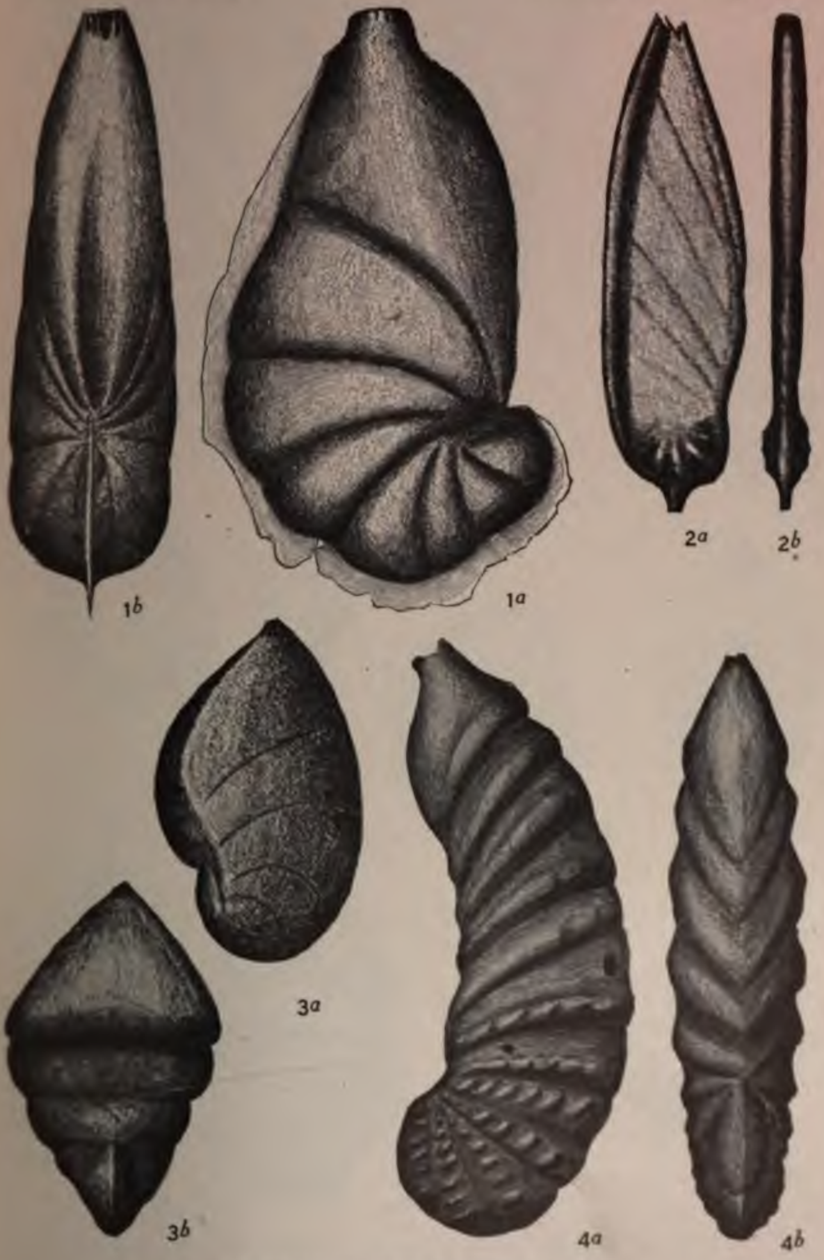

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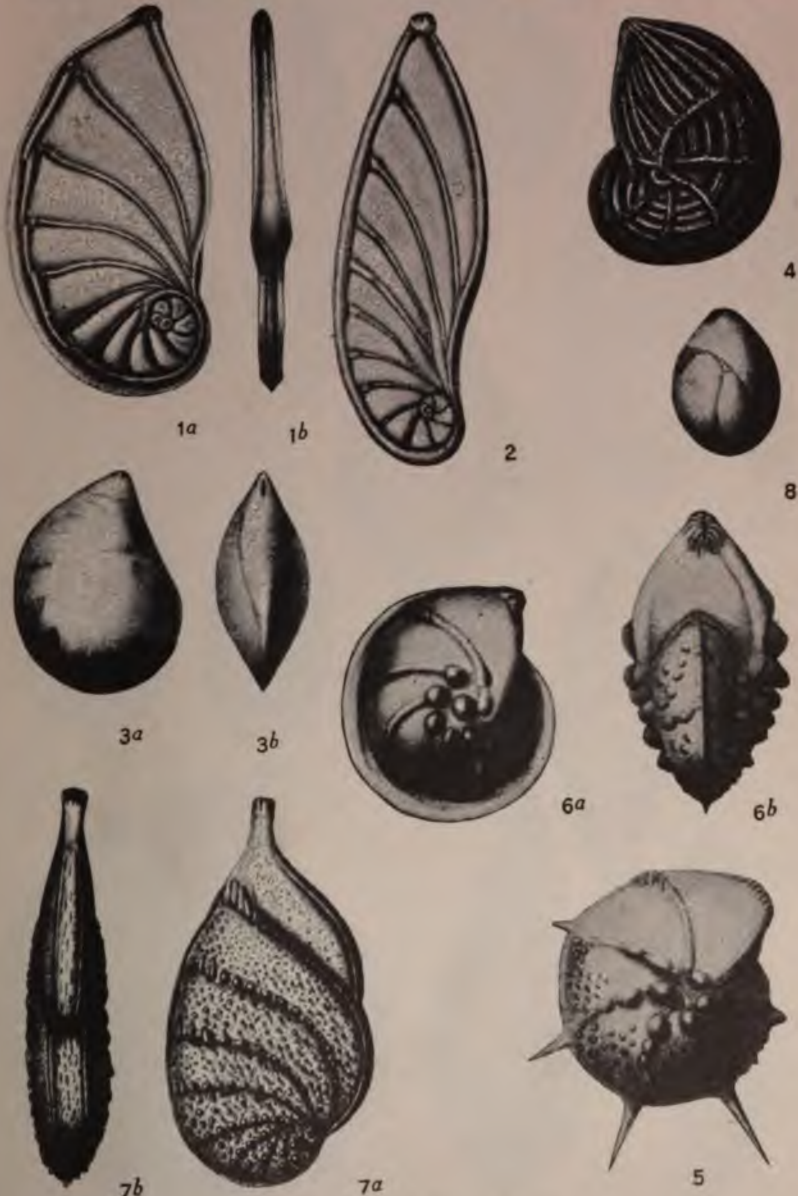
For explanation of plate see page 116.



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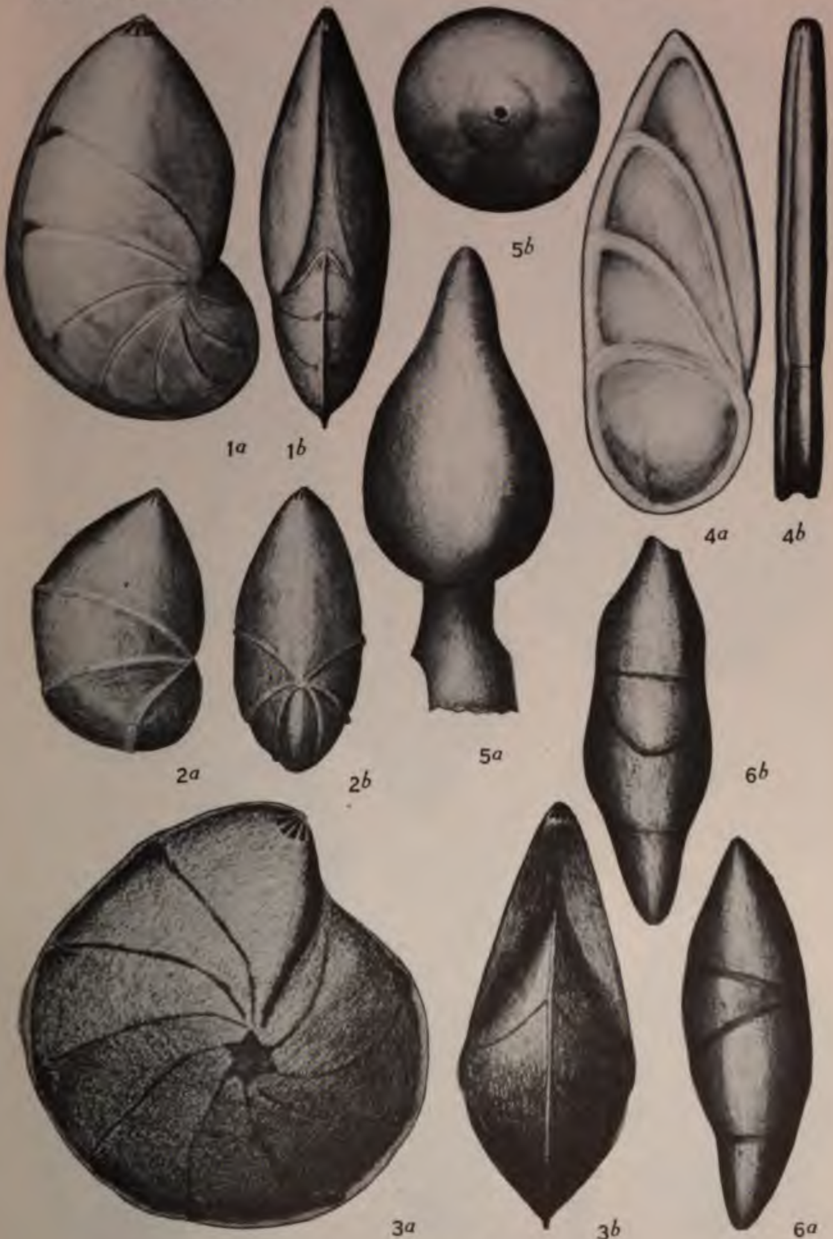

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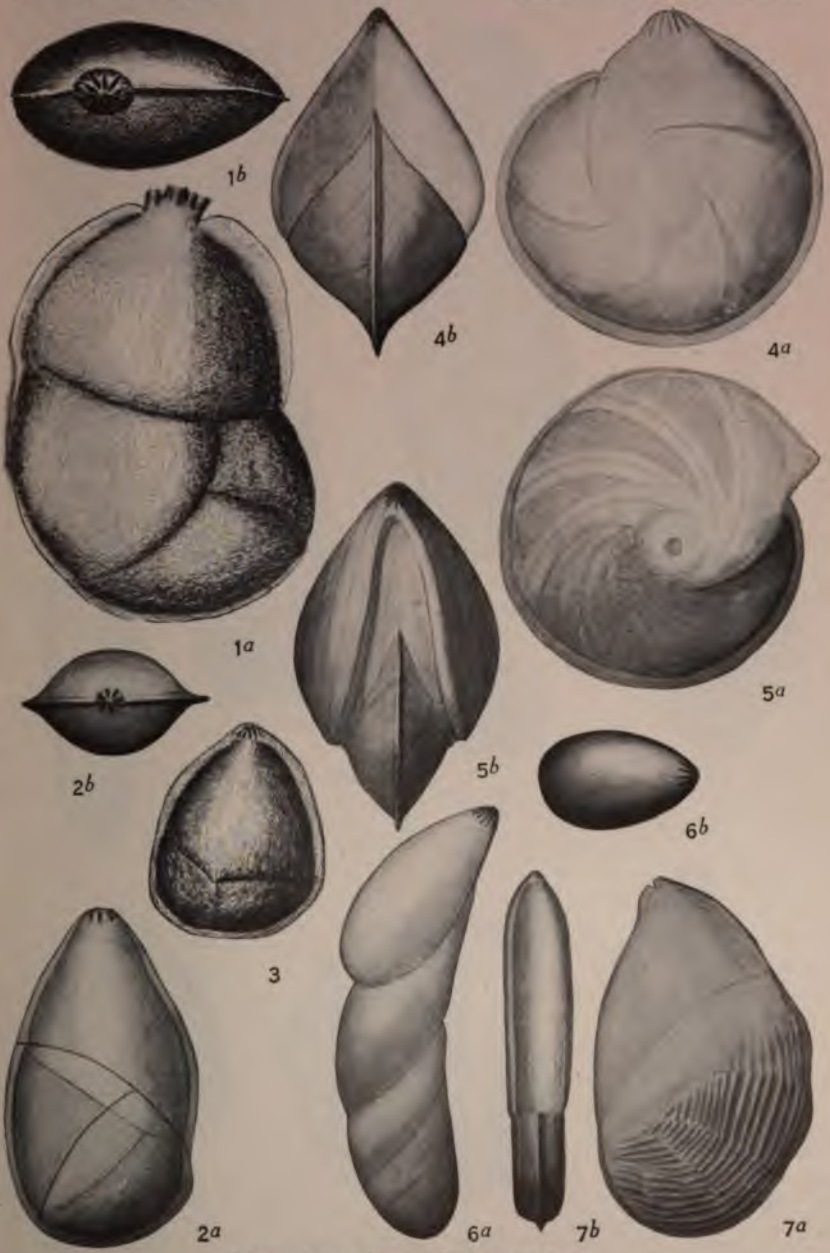

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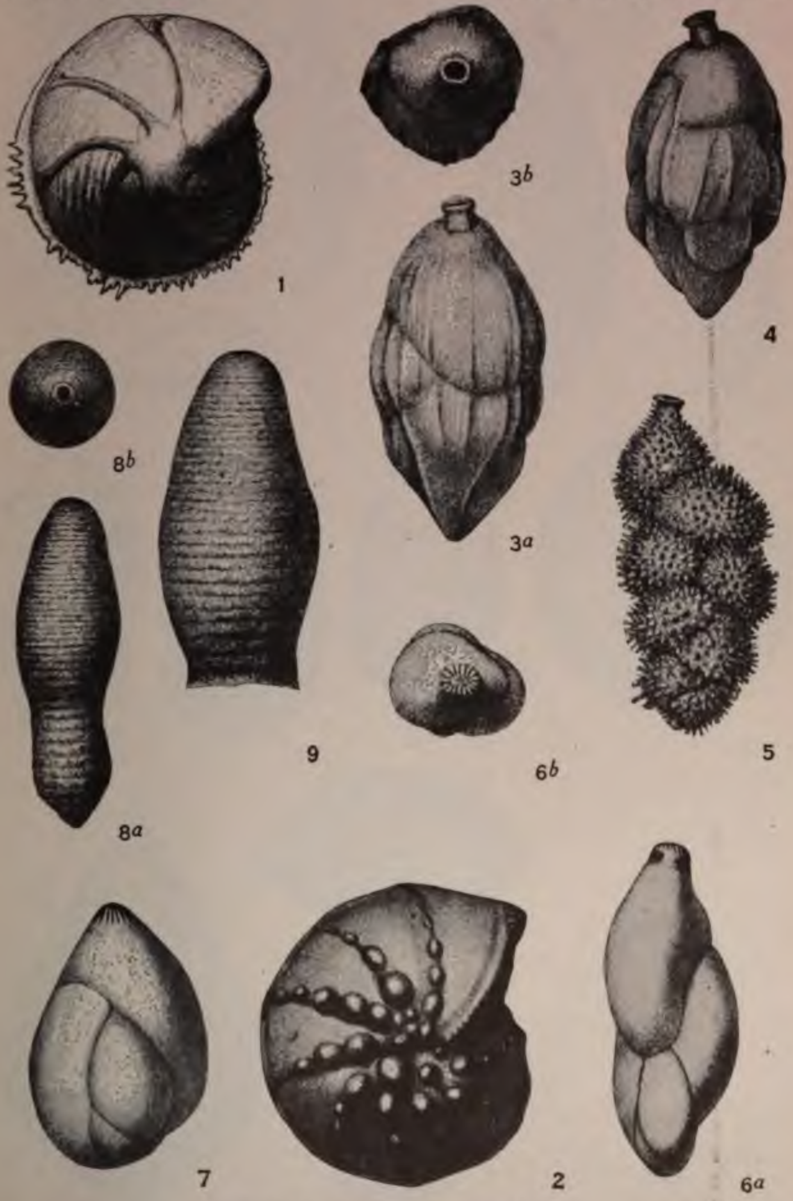

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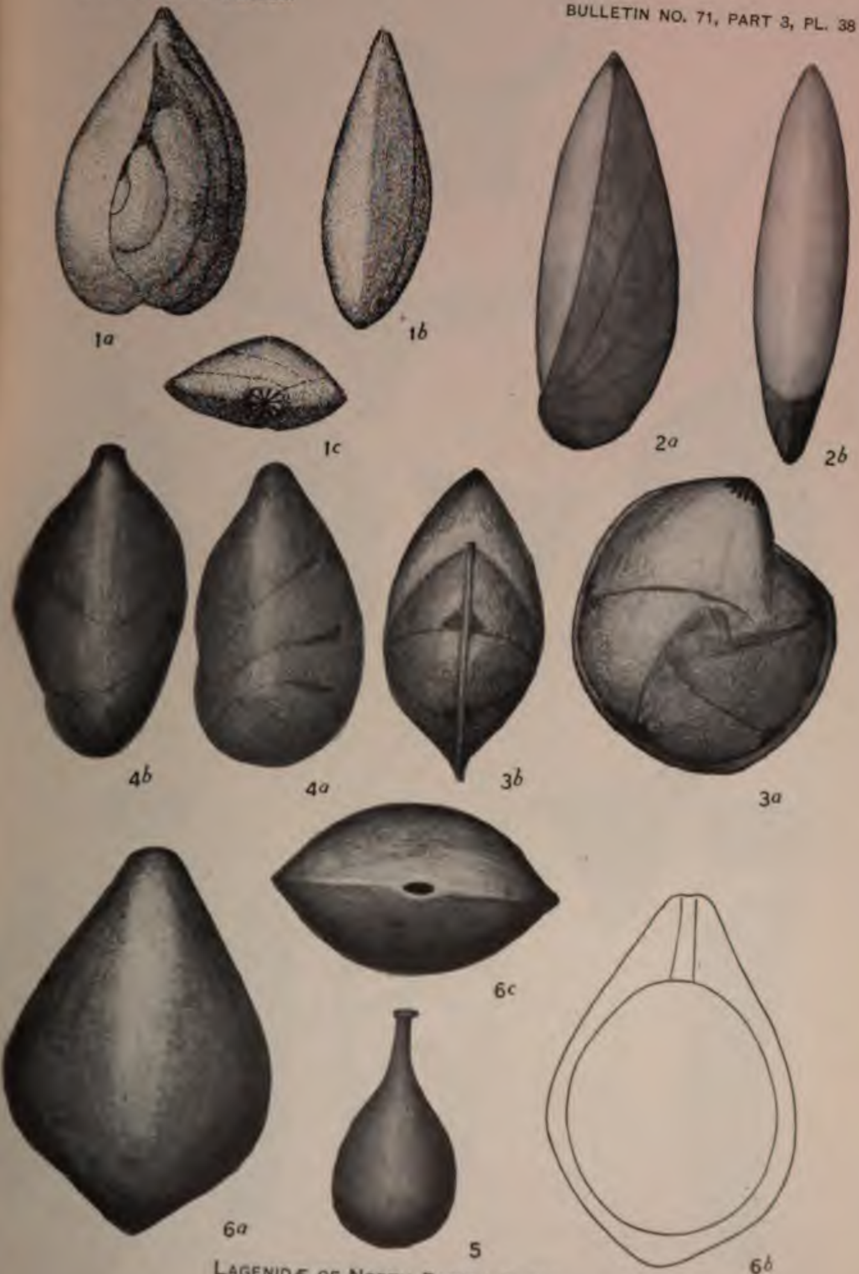

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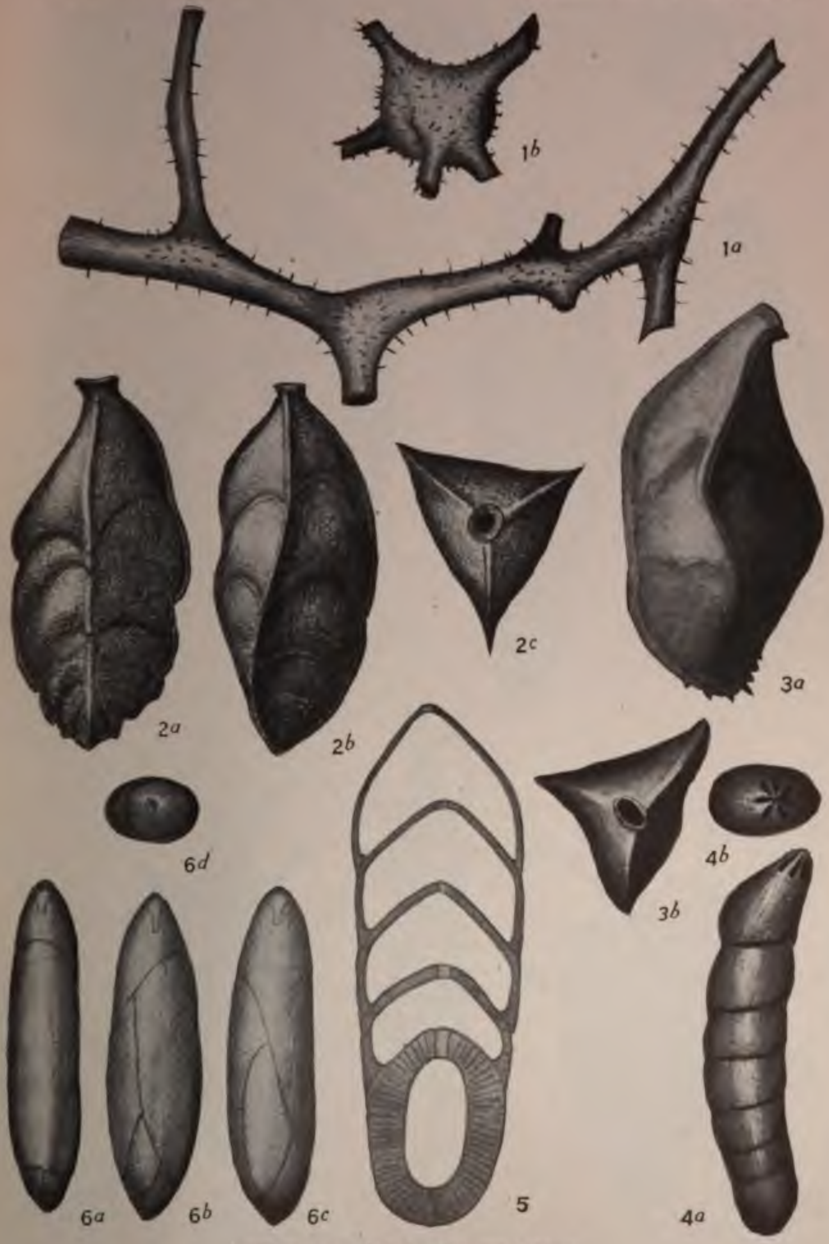

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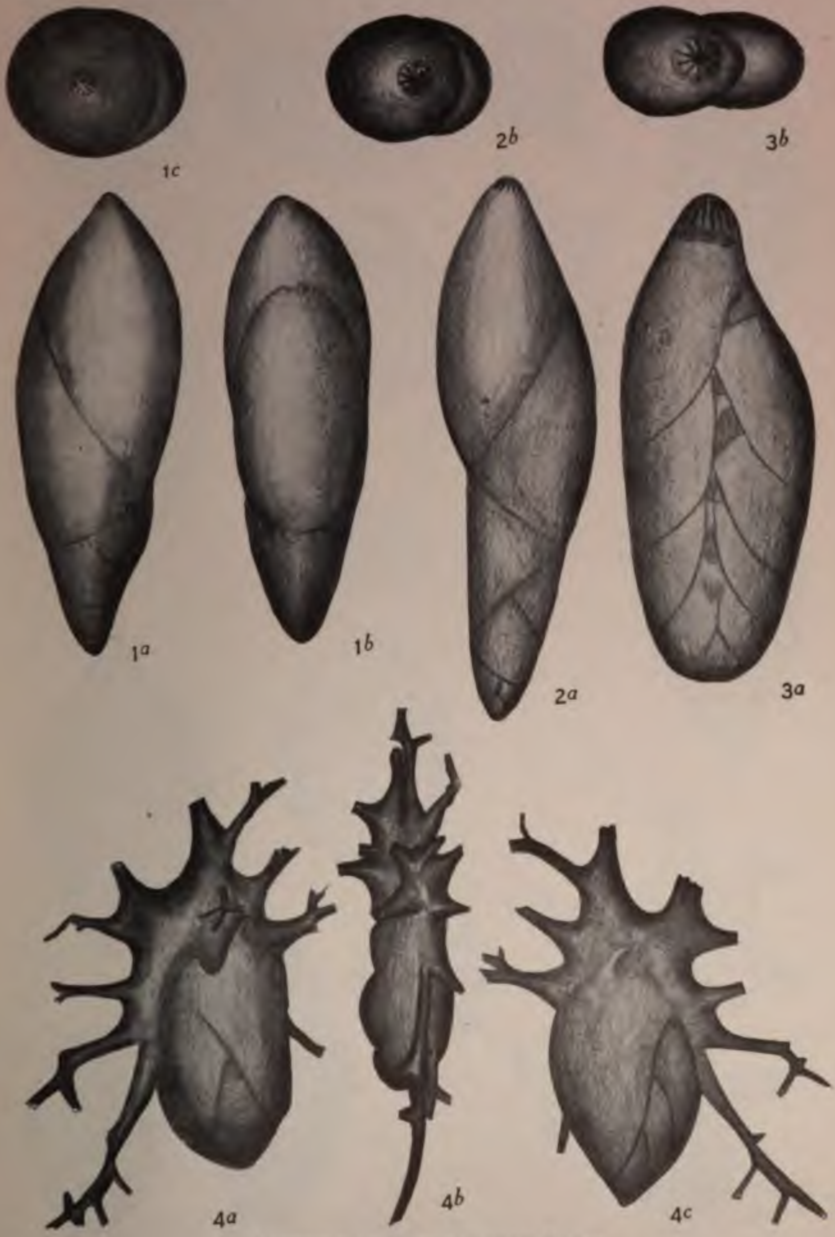

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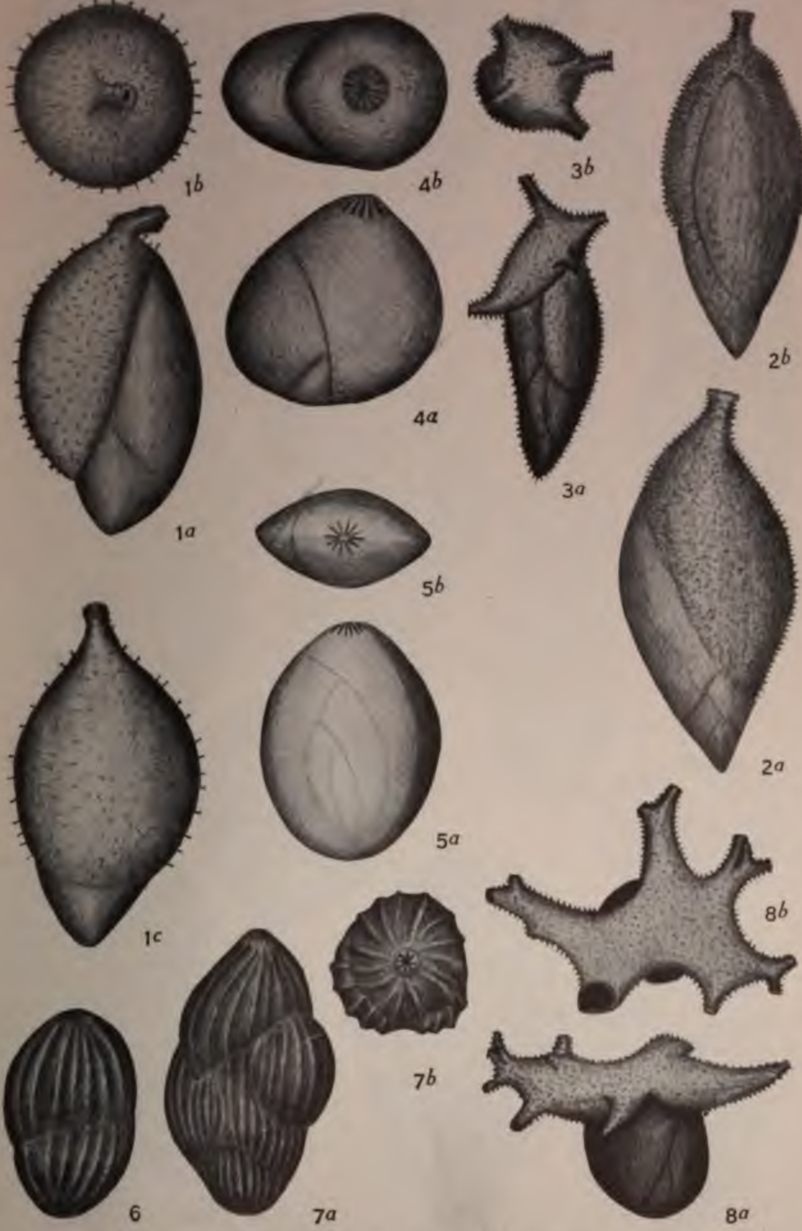

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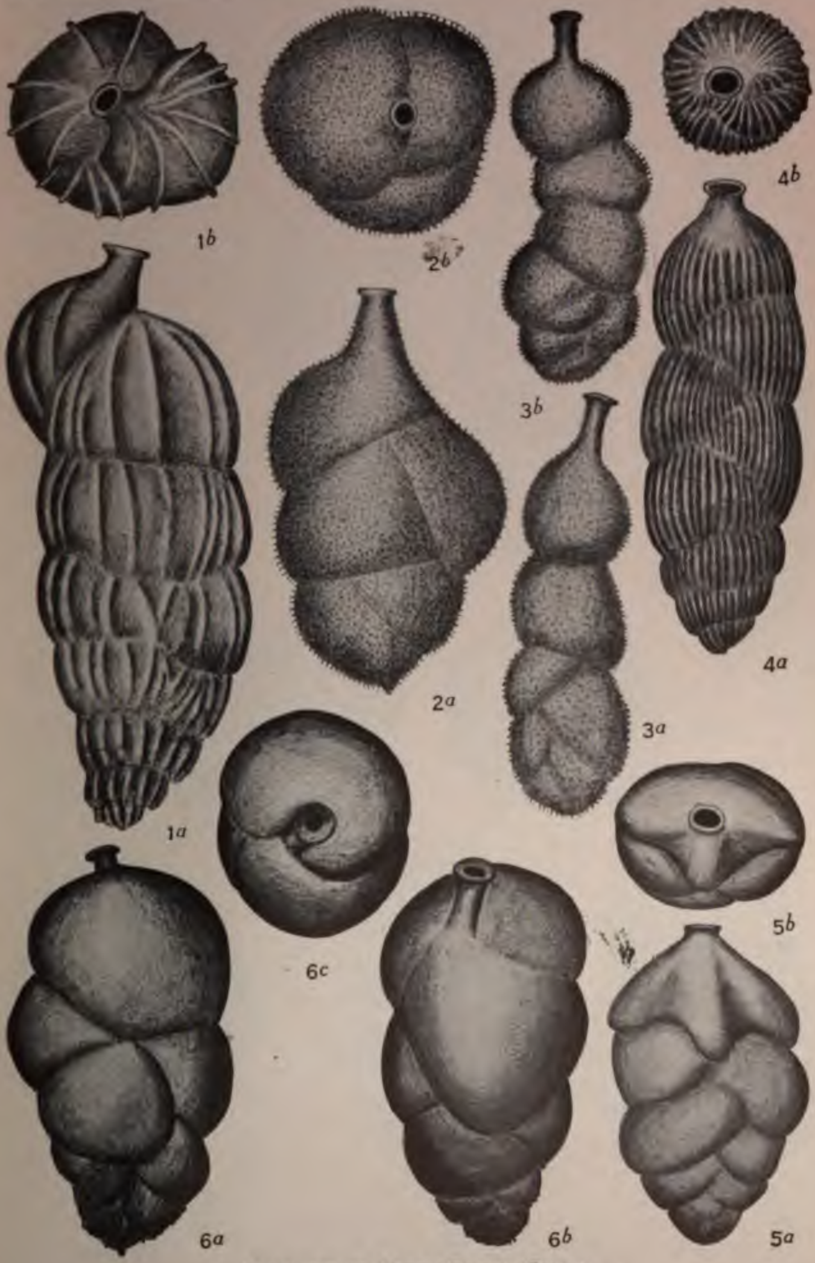

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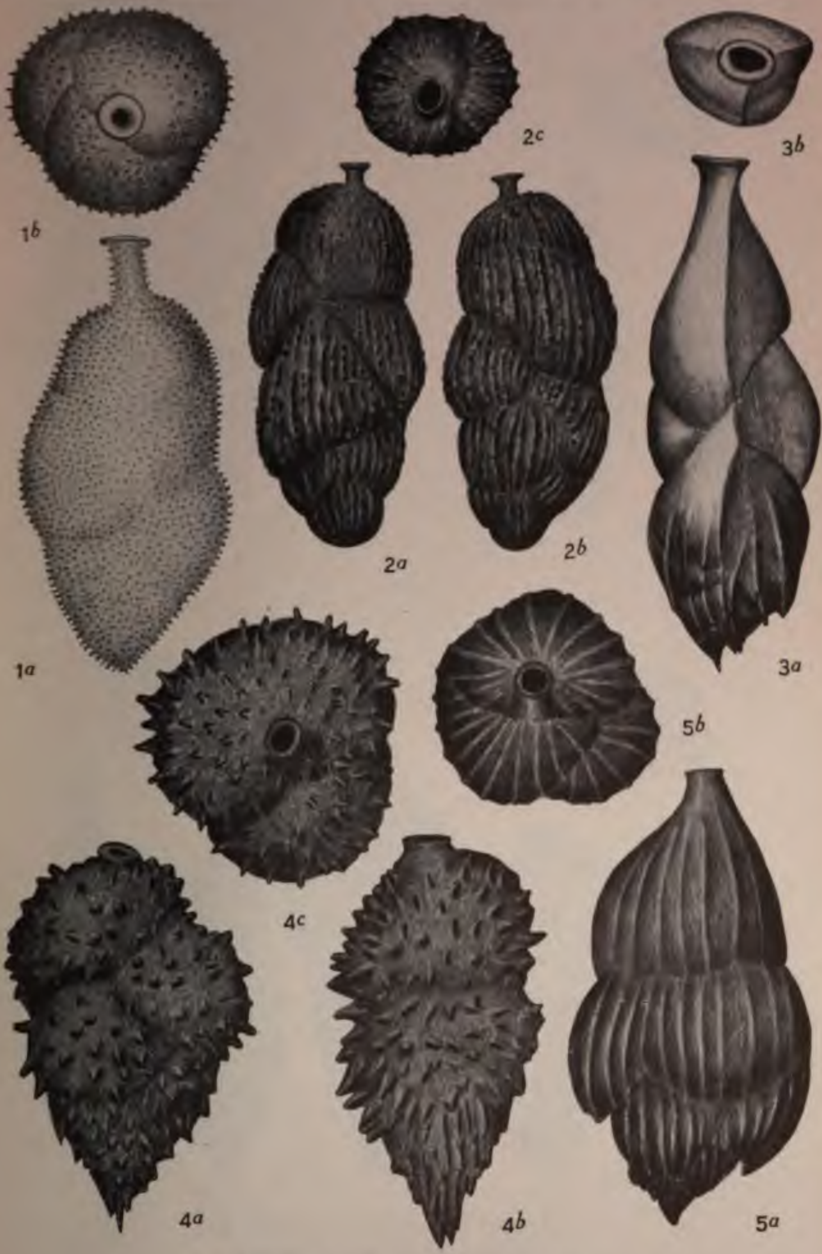

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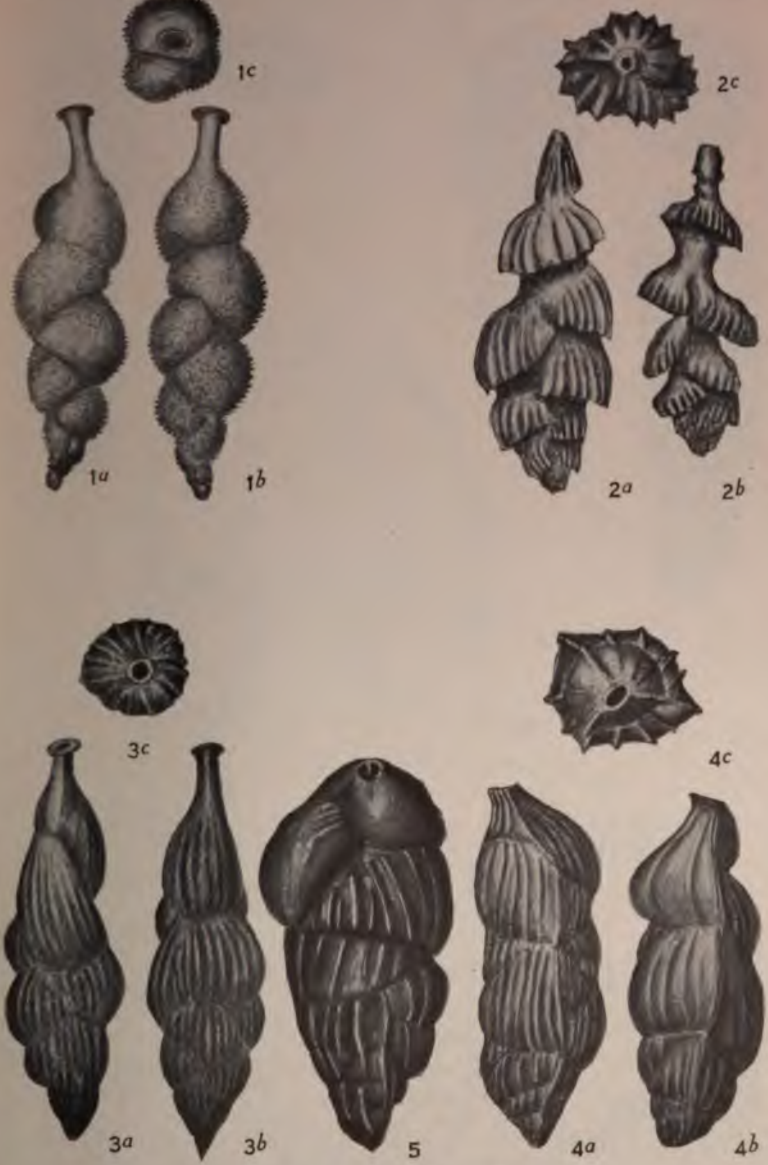

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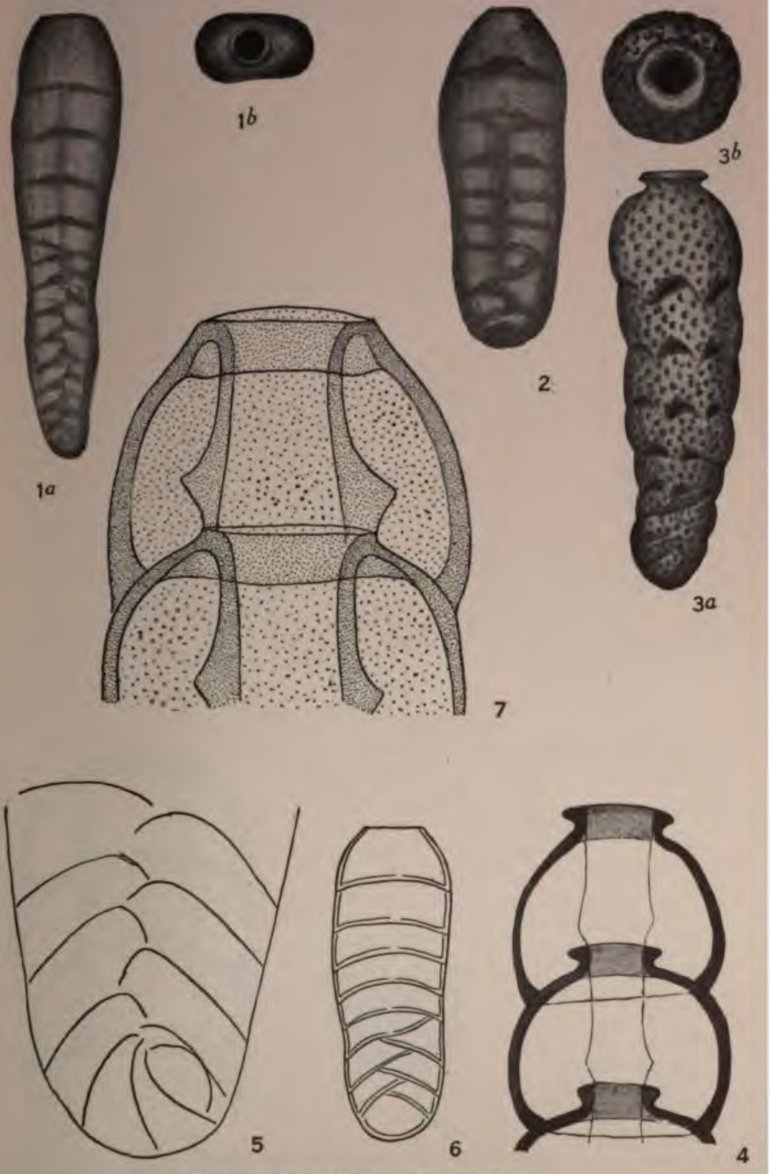

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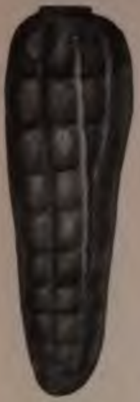

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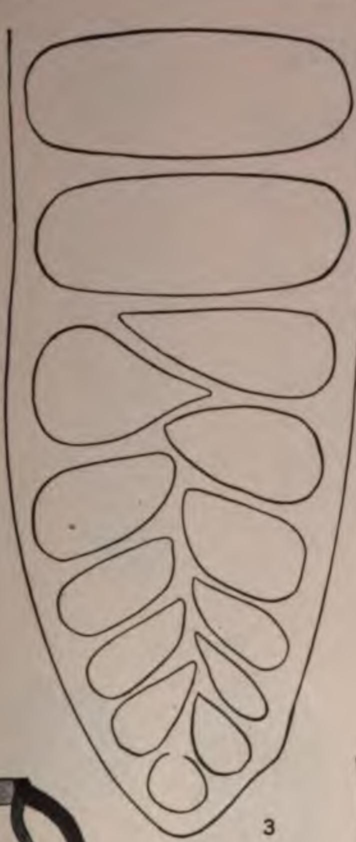

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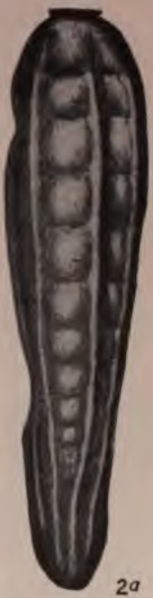

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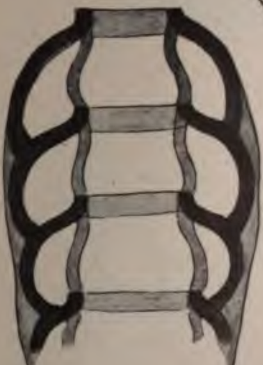

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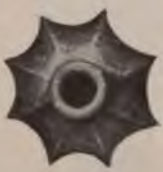

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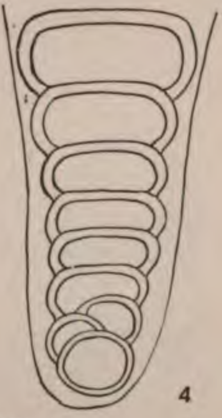

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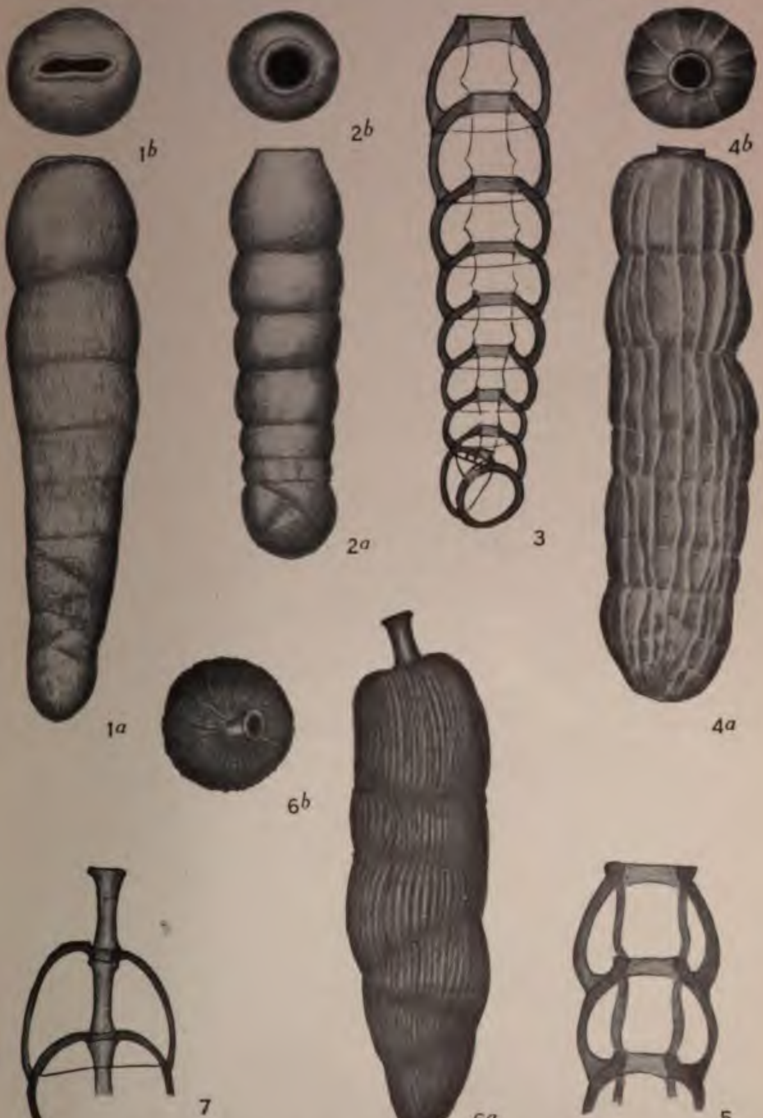

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